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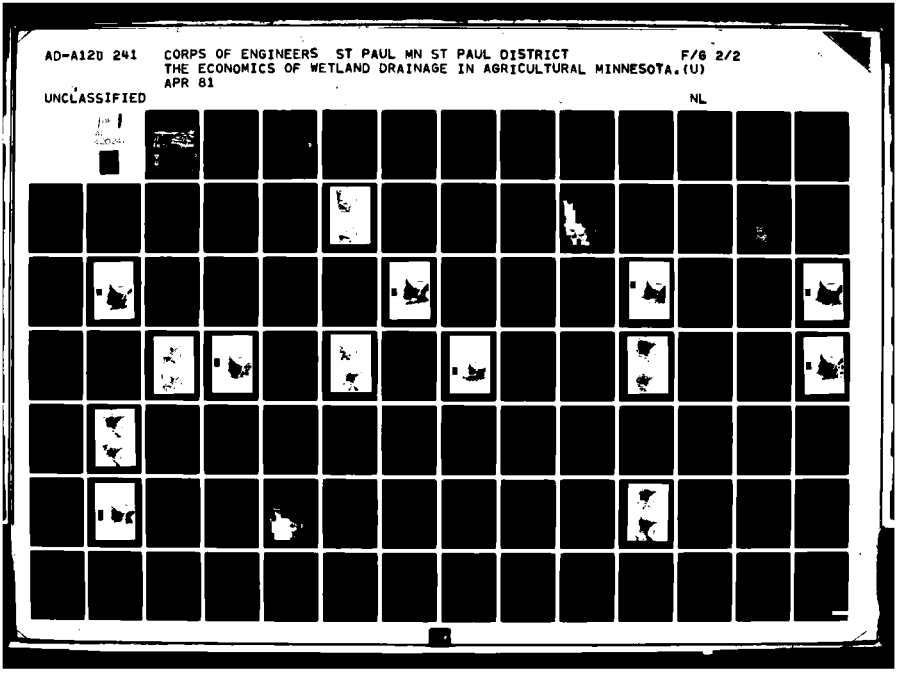

The Economics of Wetland Drainage In Agricultural Minnesota

Prepared by

U.S. ARMY CORPS OF ENGINEERS
ST. PAUL DISTRICT

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MINNESOTA WATER PLANNING BOARD

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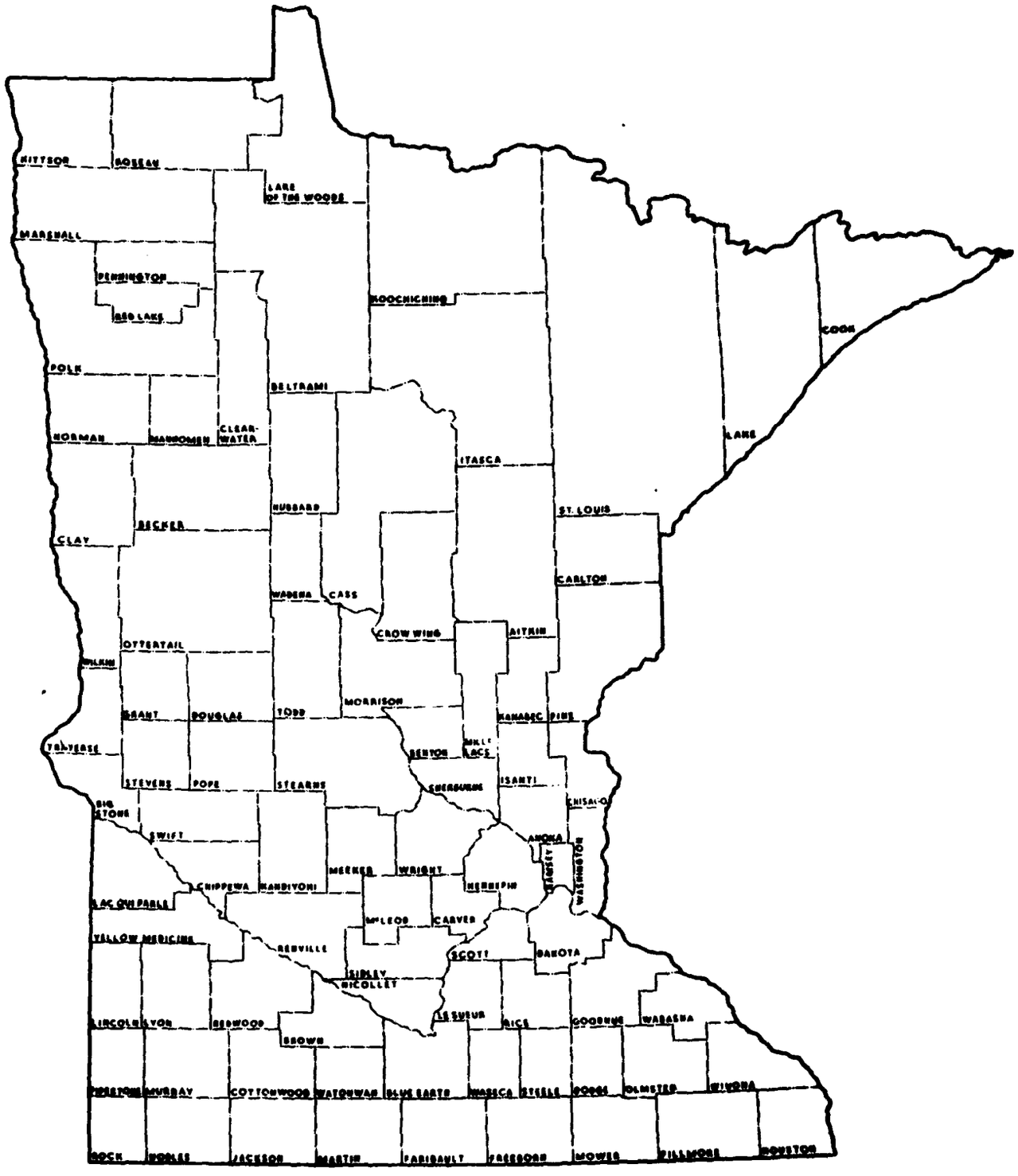
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WILKIN
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The report (1) reviews four compensation and incentive programs established in Minnesota to encourage preservation of wetlands in agricultural areas, (2) estimates the potential net return available to a farmer who chooses to drain a wetland in any of various agricultural regions of the State, and (3) compares the dollar amounts available through the preservation programs to the amount available with drainage. The four programs reviewed are the Federal Water Bank, the Fish and Wildlife Service easement and acquisition

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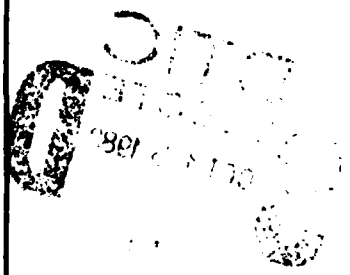

ECONOMICS OF WETLAND DRAINAGE IN AGRICULTURAL MINNESOTA

ST. PAUL DISTRICT, CORPS OF ENGINEERS
1135 U.S. POST OFFICE & CUSTOM HOUSE
ST. PAUL, MINNESOTA 55101

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ABSTRACT

The report (1) reviews four compensation and incentive programs established in Minnesota to encourage preservation of wetlands in agricultural areas, (2) estimates the potential net return available to a farmer who chooses to drain a wetland in any of various agricultural regions of the State, and (3) compares the dollar amounts available through the preservation programs to the amount available with drainage. The four programs reviewed are the Federal Water Bank, the Fish and Wildlife Service easement and acquisition program, the State Water Bank, and the State wetlands property tax credit program.

Key words:

Wetlands - agricultural uses
Wetlands - drainage
Wetlands - economics
Wetlands - government programs
Wetlands - Minnesota

PREFACE

This report would not have been possible without the advice and assistance of various people from the Corps of Engineers, the Minnesota Water Planning Board, the University of Minnesota, the Soil Conservation Service, the Minnesota Department of Natural Resources, the Minnesota Department of Revenue, and the Fish and Wildlife Service. Chuck Workman and Ed Fick of the Corps of Engineers and Brandt Richardson of the Minnesota Water Planning Board merit much of the credit for initiation and completion of this study. Also, a number of Minnesota farmers deserve recognition and thanks for their help in providing insight and information.

In addition to the people and agencies listed above, the Land Management Information Center of the Minnesota State Planning Agency, which performed the computer mapping analysis that is the foundation of the study, deserve profound appreciation. Ken Pekarek, Earl Nordstrand, and in particular Don Richards showed not only admirable technical skill but creativity and patience in developing the analysis that allowed this report to be written.

Peter J. Farmer of the Economics and Special Studies Section, Planning Branch, St. Paul District, was the principal author of this report.

The study was prepared for the Minnesota Water Planning Board under the authority of Section 22 of the Water Resources Development Act of 1974 (Public Law 93-251), which established a program of cooperative assistance to States in preparation of comprehensive plans for water resources development, utilization, and conservation. The study presents a part of the Water Planning Board's efforts to acquire information to help understand wetlands conflicts in the State. Acquisition of such information was recommended by the Board in its June 1979 report Towards Efficient Allocation and Management.

INTRODUCTION

The management of wetlands in the agricultural regions of Minnesota involves the allocation of a scarce resource among competing and sometimes conflicting uses. To the public, wetlands are valuable because they supply waterfowl and wildlife with breeding and habitat areas; contribute to flood control and groundwater recharge; serve as entrapment areas for nutrients and other sediments, thereby helping control water quality; and provide "islands" of aesthetic and genetic diversity. To the individual owner, the wetland's principal value may be achieved only if the wetland is drained and converted to agricultural use. However, conversion is not compatible with continued accrual of public benefits. Because drainage forces society to forgo the benefits of unaltered wetlands, we can identify a "social opportunity cost" of wetland conversion.

In recent years, the public benefits of wetlands have become more widely acknowledged. These benefits have also been recognized as "external" to marketplace decisions to drain or preserve. For example, a wetland in the Minnesota River basin may provide tangible flood control benefits, but its flood control function may generate no income to the farmer who owns it. The wetland's inability to provide income, in spite of its public value, may encourage the farmer to drain it and convert it to cropland.

The existence of external costs of drainage has led governments to intervene in the marketplace. A number of programs have been established to influence wetlands management decisions. Executive Order 11990 directs Federal agencies to avoid, as much as possible, activity that would destroy or modify wetlands. The Corps of Engineers has established regulations on wetland alteration under the Section 404 and Section 10 permit programs, and the Minnesota Department of Natural Resources has established regulations under the Public Waters and Wetlands Permit Program. The U.S. Department of Agriculture, U.S. Fish and Wildlife Service, and Minnesota Department of Natural Resources have established wetlands purchase and lease programs (Federal Water Bank, Easement and Acquisition Program, and State Water Bank, respectively). A property tax credit is being offered to wetlands owners in Minnesota as an incentive for preservation.

In addition to these programs, other government policies and activities may affect decisions on private wetlands management. Income tax treatment of drainage investments and the availability of an investment tax credit for tiling affect the cost of drainage. Farm policy administered through the U.S. Department of Agriculture can raise or lower the price received for a crop grown on drained land. Flood control activities of the Soil Conservation Service and Corps of Engineers have sometimes made it possible for others to expand county ditch systems. Minnesota drainage law provides an institutional and legal mechanism to carry landowners' drainage requests to county boards and allows public drainage works to be financed with bonds and special assessments.

The Minnesota Water Planning Board has described wetlands management as the "most emotional and pervasive issue in Minnesota's management of water resources" and has recommended in its Framework Water Plan that the State's wetland management program be evaluated. Moreover, the Minnesota State Planning Agency has projected that wildlife management land acquisition by State and Federal government will constitute the principal land use change in the State from 1975 to 1990, accounting for as much as 65 percent of the total number of acres expected to be converted from other land uses.[2] Finally, the U.S. Water Resources Council has recently noted that wetlands research is on the Office of Science and Technology's "top 10" list for research needs. Wetlands research has clearly come of age.

This report will attempt to help meet the objectives of the Minnesota Water Planning Board's Framework Water Plan by (1) reviewing four of the compensation and incentive programs established in the State to encourage preservation, (2) analyzing the net return available to a farmer who chooses to drain a wetland in any of various agricultural regions of the State, and (3) comparing the dollar amounts available through the preservation programs to the amount available through drainage. The four programs to be reviewed are the Federal Water Bank, the Fish and Wildlife Service easement and acquisition program, the State Water Bank, and the wetlands property tax credit program. Questions to be addressed by the report are:

- What are the levels of economic incentives or compensation offered through government programs affecting wetland drainage? To what kinds of land does each program apply?

- How does the potential economic return from drainage vary among agricultural regions of the State? What are the factors that determine net economic return? Which factors are most important?

- How do incentive or compensation levels compare with the potential economic returns from wetland drainage in various regions of the State? What conclusions might be drawn on the adequacy of these wetland preservation programs?

METHODS FOR ESTIMATING ECONOMIC RETURNS ON DRAINED WETLANDS

Three distinct techniques could have been used to estimate the potential economic return to a farmer from drainage. The method chosen for this study involves "partial budget analysis," or the estimate of the changes in a farmer's annual budget (costs and revenues) resulting from decisions to drain or preserve a wetland. If the farmer converts the wetland to cropland, he will incur costs for drainage, fertilizer, seed, chemicals, fuel, and labor. In return, he may earn income from the sale of crops grown on the drained wetland. The partial budget technique quantitatively evaluates and combines the elements of costs and income to estimate the potential returns from drainage.

Another method for estimating returns would be to simply ask farmers how much drainage would be worth to them. Data collected from farmers could be averaged to derive an estimate or series of estimates on the potential economic return from conversion of wetlands to cropland. The advantage of this approach is that it introduces the element of farmers' perceptions into the analysis. Perceptions are important because people often act on intuitive judgment rather than formal, quantitative analysis. However, this approach has its shortcomings. The principal flaw is that it does not allow for the examination of the relative importance of the various components of drainage returns.

It is not possible to determine how returns would be affected by a change in crop prices, for example, when using the interview method. This technique was rejected because of its limitations.

Examination of land value data would be another alternative to the partial budget method. For example, sales dat could be reviewed for transactions involving cropland, wetlands with legal restrictions on drainage, and unencumbered wetlands. A linear programming model might be constructed to analyze these data. By comparing the estimates of the sales value of wetlands for which drainage is allowed with those having legal restrictions on drainage, one could draw some conclusions on how the potential return from drainage is evaluated in the marketplace. While this approach seems promising, the results obtained by others have been somewhat discouraging.[3] One possible reason is that the mathematical expressions used to model land sales activity fail to incorporate the emotional factors that inevitably come into play in a land transaction. Because of the limited success of others' attempts with this method, it, too, was rejected for this study. A brief review of land value analysis for wetland research is presented in Appendix B.

The partial budget method requires compilation of data regarding gross returns on drained wetlands, production costs, and drainage costs. Some of this information is readily calculated, but some is difficult to obtain. Use of this technique requires making many assumptions, each of which affects results in some way. However, the problems involved are not insurmountable. Moreover, the technique is not unfamiliar: the Corps of Engineers has used it for many years to estimate flood damage potential in agricultural areas. Therefore, it was chosen for this report. Documentation of assumptions used for analysis of economic returns from drained wetlands is given in Appendix A.

DEFINITIONS AND CLARIFICATIONS

At the outset, four points concerning this study should be clarified. The first is one of semantics. For this report, "wetlands" refers to those marshy areas which hold water year-round, except in very dry years,

and which can be farmed no more often than once every 10 years on the average. These areas would correspond roughly to Type 3, 4, or 5 wetlands under the classification scheme published in 1956 by the Fish and Wildlife Service as Circular 39. "Wetland drainage" is physical activity to remove subsurface and/or surface water from a wetland, enabling cultivation in virtually all years. The term is not identical to "general farm drainage," which improves the productivity of areas already cultivated.

The second point is that this report will not attempt to evaluate the various public values of wetland resources. The effort is not unimportant. Quantitative evaluation of the public value of unaltered wetlands has the potential to significantly aid the development and administration of wetlands management policy. However, the first step in the establishment of appropriate policy is to understand what happens with wetland alteration and why. Therefore, analyses in this report will be done strictly from the wetlands owner's perspective, rather than a broader social perspective.

The third point is that the analysis does not evaluate all the economic factors that influence a farmer's drainage decision. The analysis assumes, for example that a farmer will have no income from an unaltered wetland although he might cut wild hay, rent hunting rights, or trap furbearers in the wetland. The analysis also assumes that drainage and cultivation will increase income only through additional crop production and not by alleviating wildlife or weed infestation or reducing the probability of having machinery damaged from being mired in a wet spot. The analysis does not consider the case of a farmer who is assessed for a county ditch system that he did not want, and who can recoup on this undesired investment only by converting to cropland those wetlands that the county ditch was designed to drain. However, the analysis of this report is felt to include the most critical and most common factors affecting drainage returns.

The final point is that the results of analysis in this report are general. Any findings that drainage generally appears to have a positive or negative net return in a given area do not mean that all drainage work in the area is necessarily "economically feasible" or "economically infeasible." Perhaps more importantly, indications that drainage in an area might have positive economic returns to a wetland owner do not mean that the wetland should be altered. Because analyses are not done from a broader social perspective, the results cannot be used alone to decide whether drainage is socially optimal, but rather to illustrate some of the economic considerations involved in the decision.

STUDY AREA

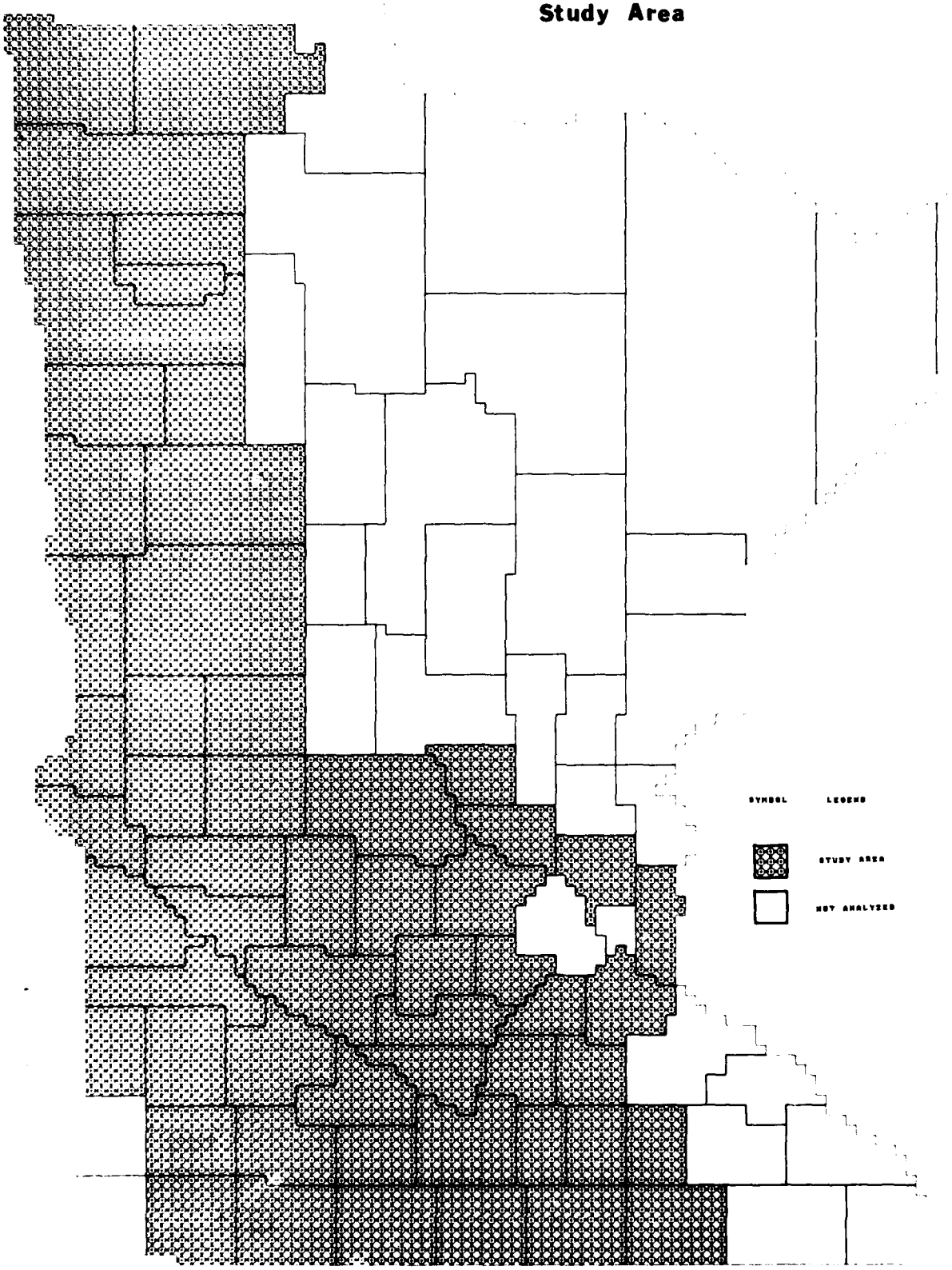
This report will deal only with that portion of the State where statistics show agriculture to be predominant and where District Conservationists with the Soil Conservation Service have noted agricultural drainage of wetlands to be common. Map 1 displays the study area, which includes the highly productive corn- and soybean-growing areas in the southern one-third of Minnesota and the sunflower, small grain, and sugar beet production areas of the western one-third of the State.

Although scattered farms are found in the northeastern portion of the State, this area was not included in the study area. Conversion of wetlands to croplands is not common in this area. The southeastern and far southwestern corners of the State were also eliminated. Both are sharply dissected by streams and rivers with relatively steep slopes, and pothole-type wetlands have never been prevalent. Finally, Hennepin and Ramsey Counties were eliminated because they are highly urbanized.

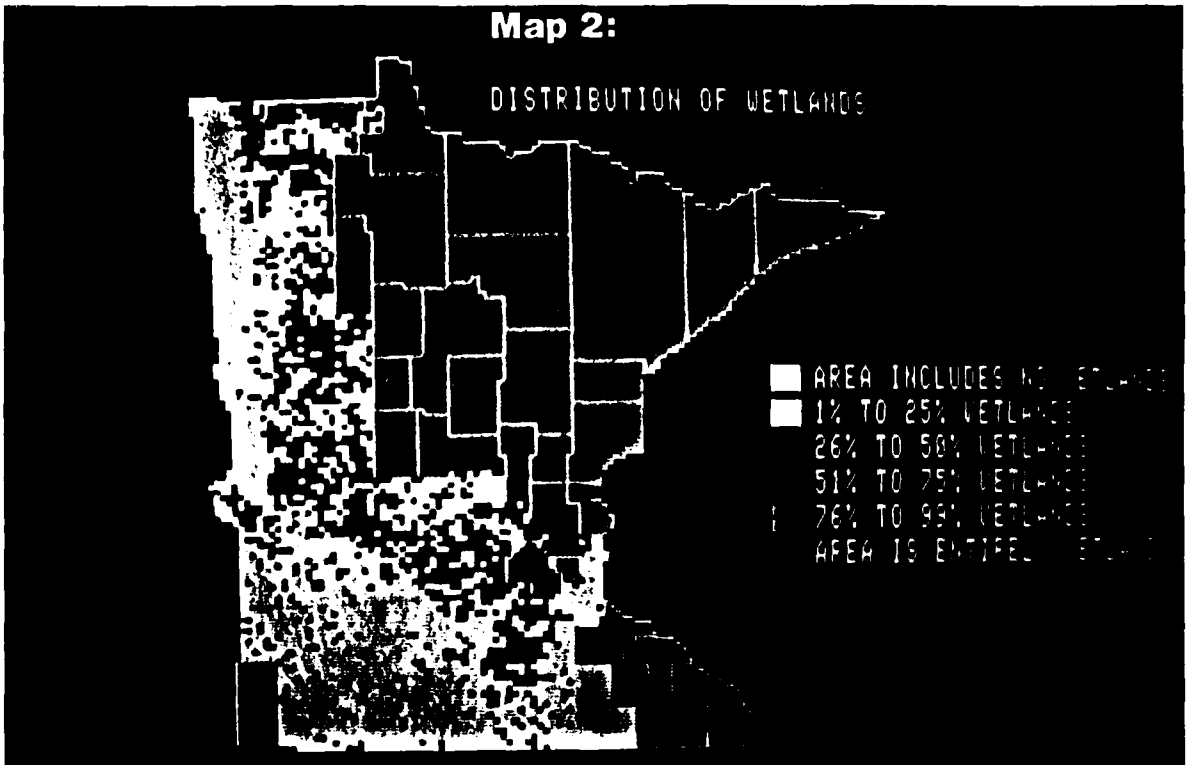
Map 2 shows the distribution of wetlands within the study area. This map was prepared with data from the Minnesota Land Management Information System (MLMIS), a computer-based data bank and analysis tool administered by the State Planning Agency. For this map, the State has been divided into 5-square-kilometer grid cells, and the percentage of 40-acre units within each of these grid cells that has been classified as "marsh" has been tabulated. As the map shows, wetlands are rare in the Red River Valley and are sparsely scattered through the southern regions of the State.

Map 1 :

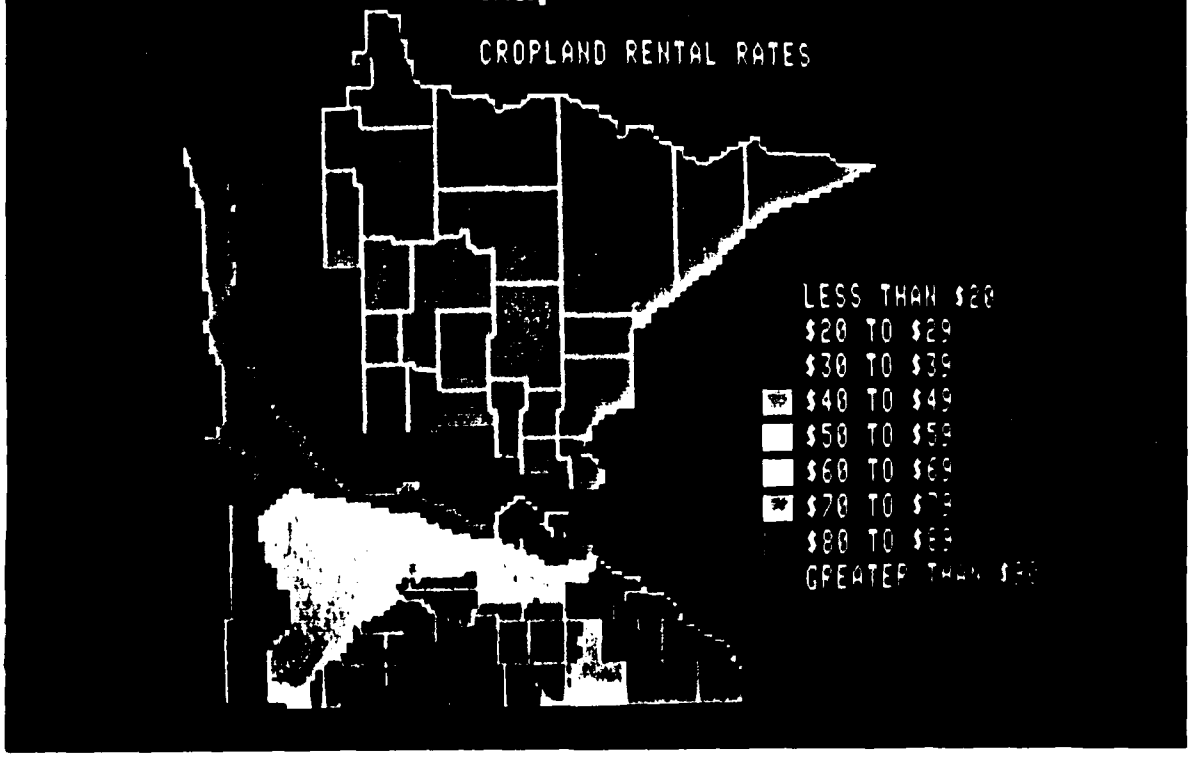
Study Area



Map 2:


DISTRIBUTION OF WETLANDS
AREA INCLUDES NO
1% TO 25%
26% TO 50%
51% TO 75%
76% TO 99%
AREA IS ENTIRELY

Map 3:


CROPLAND RENTAL RATES
LESS THAN $20
$20 TO $29
$30 TO $39
$40 TO $49
$50 TO $59
$60 TO $69
$70 TO $79
$80 TO $89
GREATER THAN $89

Wetlands are most extant in the woodland-prairie border transition area extending in a northwesterly arc from the Twin Cities to East Polk and Clearwater Counties and in the wet and brush prairie regions farther north.

The relative value of agricultural land within the study region is shown on Map 3. This map is based on Minnesota Department of Revenue data that has been stored in MLMIS. It displays the annual rental rate paid for an acre of cropland in 1979 and is based on information supplied by 1,532 individuals who were considered knowledgeable about farm rentals. Cropland rental rates are a good proxy for land productivity. Soil type and climate are the two most critical determinants of cropland rental rates. Rents are highest in south-central Minnesota and decrease as one moves into areas of less rainfall, a shorter growing season, and lower soil productivity. The range of rents is great, with a high of more than $90 per acre per year and a low of less than $20 per acre per year.

DESCRIPTION OF FOUR COMPENSATION AND INCENTIVE PROGRAMS

This section will describe four compensation and incentive programs: the Federal Water Bank, the Fish and Wildlife Service easement and acquisition program, the State Water Bank, and the State-paid wetlands property tax credit. These programs offer economic incentives that may affect a farmer's decision to drain. The following paragraphs will present the four programs and estimate the dollar amount available through each per year per acre of unaltered wetland.

FEDERAL WATER BANK

The Federal Water Bank (FWB) program was established in 1970 and is administered by the Agricultural Stabilization and Conservation Service (ASCS) of the U.S. Department of Agriculture. Under the program (as amended by Public Law 96-182), the ASCS is authorized to enter into 10-year agreements with owners of Type 1-7 wetlands if:

- The owners have applied for the program.

- The wetlands have been noted by the Soil Conservation Service and local soil and water conservation committees as having conservation value.

The agreements stipulate an annual payment to the owner in return for a promise not to drain, burn, fill, or otherwise destroy the wetland and a promise to carry out the conservation and development plan that is devised for the wetland. (The ASCS would arrange cost sharing for this plan.) The agreement may include adjacent uplands important for the nesting and brooding of migratory waterfowl. Payment rates established at the start of the 10-year agreement are reviewed at the end of 5 years and adjusted to reflect changes in crop or land values.

Not all Minnesota counties are eligible for this program. The counties in the study area that are eligible are shown on Map 4. One eligible county (Todd County) is outside the study area. A committee made up of representatives from the Soil Conservation Service, Agricultural Extension Service, U.S. Fish and Wildlife Service, and Minnesota Department of Natural Resources' Division of Fish and Wildlife meets annually to advise the ASCS on designation of eligible counties, using whatever criteria they deem appropriate. The ASCS makes the final decisions. The same process is used to establish the payment schedule for agreements made in that year.

The current schedule calls for annual payments of $8 to $10 per acre of wetland, with the lower payment going for land subject to Fish and Wildlife Service easements restricting drainage. Payments of $6 per acre may be made for woodland adjacent to the wetland, and payments between $20 and $55 per acre can be made for adjacent cropland or grassland. (Adjacent acreages are acquired to provide waterfowl nesting habitat.) The payments for adjacent land are determined by cropland capability class and based on 1979 corn yields for the eligible counties. A list of Minnesota counties eligible in 1980 and 1980 payment rates are given in the following table.

Minnesota counties eligible for the Federal Water Bank Program and approved payment rates for 1980

1. Minnesota counties eligible in 1980:

Becker	Grant	Murray	Scott
Big Stone	Kandiyohi	Nicollet	Stearns
Blue Earth	Lac qui Parle	Norman	Stevens
Brown	Le Sueur	East Otter Tail	Swift
Carver	Lincoln	West Otter Tail	Todd
Clay	Lyon	East Polk	Traverse
Cottonwood	Mahnomen	Pope	Waseca
Douglas	McLeod	Renville	Wright
Freeborn	Meeker	Rice	Yellow Medicine

2. Approved payment rates for wetlands in 1980:

$10 per acre per year
$8 per acre per year if wetlands are under U.S. Department of the Interior or State drainage easement.

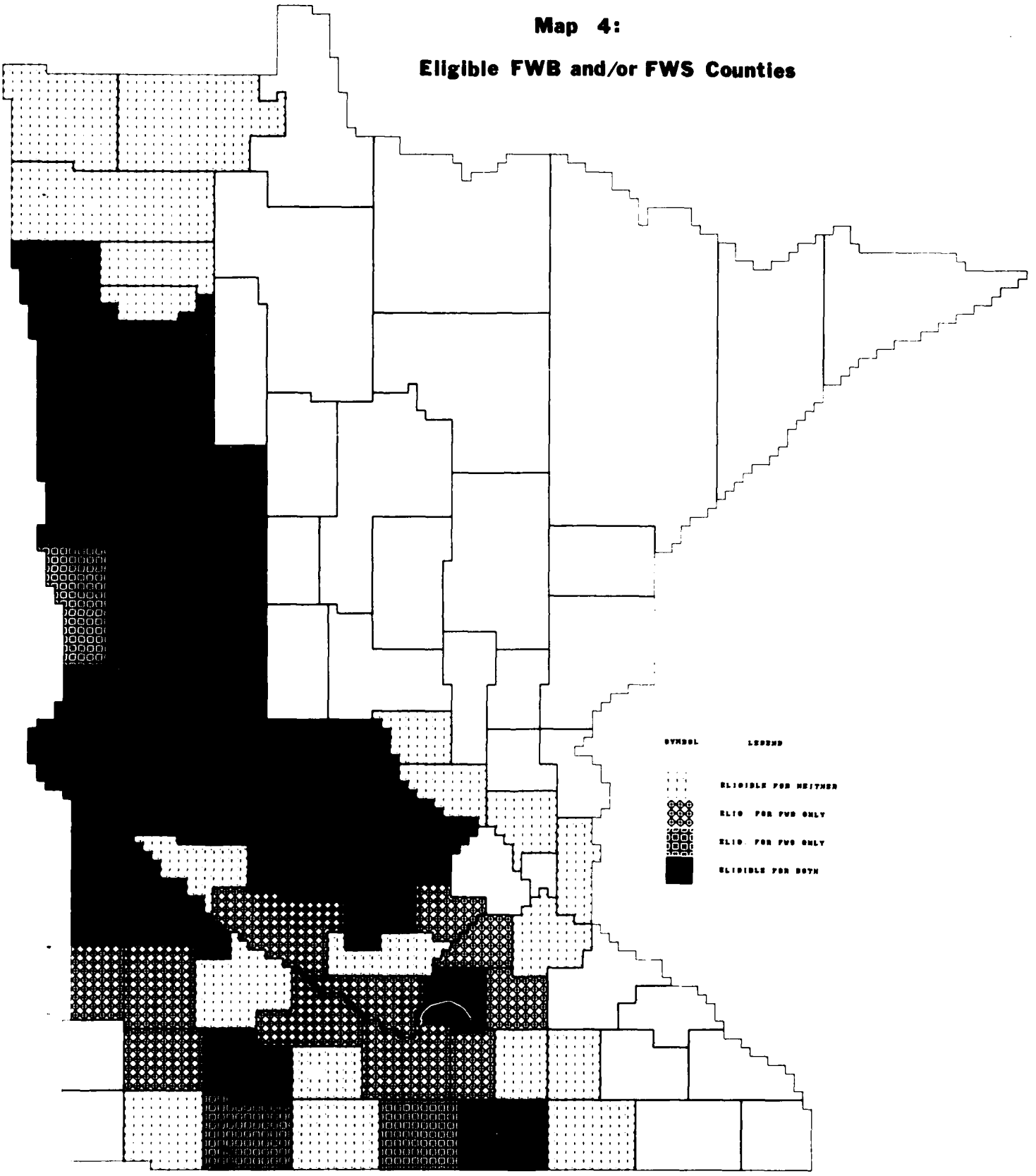
3. Approved payment rates for adjacent acreages (uplands) in 1980:

Rate 1	Rate 2	Rate 3	Rate 4
For cropland capability Classes I, II, and III	For cropland capability class IV	For grassland and all other eligible land including types I and II wetlands.	Woodland
100 percent of established farm 1979 corn yield x $0.75 per bushel. Maximum payment cannot exceed $55 per acre.	70 percent x rate 1. Maximum cannot exceed $40 per acre.	40 percent x rate 1. Maximum cannot exceed $25 per acre.	$6 per acre.

SOURCE: Agricultural Stabilization and Conservation Service, St. Paul.

Map 4:

Eligible FWB and/or FWS Counties



The number of eligible counties, the number of acres enrolled in the program, and the level of payments per acre have increased steadily since 1972 when the program was initiated. As of 30 May 1980, 84,915 acres were enrolled in the program in Minnesota. Of the total, 21,696 acres are wetlands and 63,219 acres are uplands. The mean size of an agreement was for 15 acres of wetland and 42 acres of upland. Annual payments as of 30 May 1980 totaled $1,334,396 for the State. Data on enrollment by county for each year the program has been operating are listed in the following table.

In 1979 and 1980, all funds allocated for new agreements in Minnesota were spent before the end of the fiscal year. This development represents a change from the first 7 years of the program's operation, when low participation meant that not all available money was spent. Per-acre payments in previous years were at lower levels. Officials believe that the higher payment levels, along with relatively low crop prices, explain the increase in participation. Officials also note that interest in wildlife is characteristic of farmers enrolled in the program.

Map 5, "FWB Wetlands Payment," displays the counties where wetlands are eligible for the annual $10-per-acre payment through the FWB program.

Federal Water Bank Program: acreage enrolled by county, 1972-1980

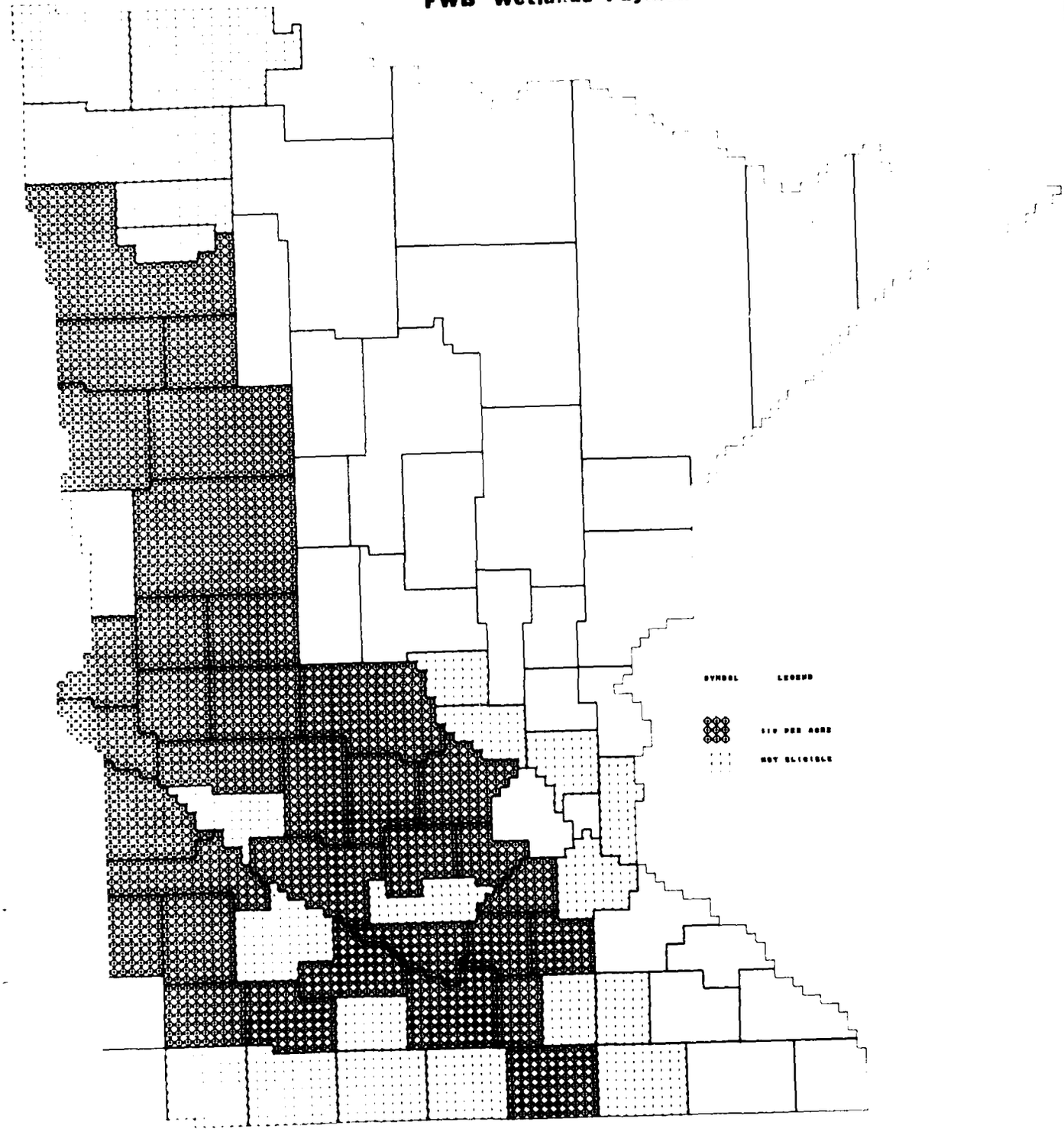
County	Acres enrolled for first time in each year									Cumulative acres enrolled			Total annual payments
	1972	1973	1974	1975	1976	1977	1978	1979	1980	Wetlands	Adjacent to wetlands	Total	
Becker	*	*	*	*	0	586	71	743	422	433	1,389	1,822	$29,335
Big Stone	707	901	1,542	1,053	677	869	1,338	1,715	428	2,448	6,782	9,230	176,067
Blue Earth	*	*	*	*	*	59	0	160	852	376	695	1,071	19,128
Brown	*	*	*	*	*	0	128	13	98	45	194	239	6,989
Carver	*	*	*	*	*	14	45	41	50	53	97	150	2,537
Clay	*	*	*	*	*	406	341	42	590	445	934	1,379	20,092
Cottonwood	*	*	*	*	*	36	169	104	0	60	249	309	9,185
Douglas	1,404	49	2,438	102	399	1,183	627	1,377	404	1,665	6,318	7,983	117,634
Freeborn	*	*	*	*	*	151	73	137	102	123	340	463	9,287
Grant	30	0	1,557	368	112	709	122	355	139	1,075	2,317	3,392	44,665
Jackson	289	0	0	0	0	0	0	0	0	124	165	289	3,421
Kandiyohi	802	186	1,768	434	344	593	555	54	205	1,263	3,678	4,941	82,198
Lac qui Parle	204	383	0	0	0	0	275	18	314	316	878	1,194	21,680
Le Sueur	*	*	*	*	*	178	400	133	177	284	604	888	16,965
Lincoln	*	*	*	*	*	0	89	0	0	22	67	89	1,775
Lyon	*	*	*	*	*	46	28	0	0	21	53	74	1,653
Mahnomen	450	867	854	528	221	657	1,257	227	760	1,187	4,634	5,821	81,953
McLeod	*	*	*	*	*	0	376	409	330	284	831	1,115	23,017
Meeker	949	0	1,152	495	189	506	980	506	589	1,441	3,925	5,366	87,956
Murray	*	*	*	*	*	50	0	14	0	10	54	64	1,803
Nicollet	*	*	*	*	*	0	0	0	0	0	0	0	0
Norman	*	*	*	*	*	45	140	78	0	70	193	263	5,033
Otter Tail (east)	*	*	*	*	*	0	0	28	461	133	356	489	8,071
Otter Tail (west)	1,793	453	2,910	2,226	3,311	1,859	1,162	651	493	4,082	10,776	14,858	162,108
Polk (east)	1,351	1,035	751	308	165	963	876	742	799	1,684	5,306	6,990	99,199
Pope	0	0	2,357	1,110	719	921	739	827	412	1,572	5,513	7,085	115,012
Renville	*	*	*	*	*	*	*	0	215	75	140	215	5,899
Rice	*	*	*	*	*	0	657	85	70	162	650	812	19,580
Scott	*	*	*	*	*	20	493	259	0	175	597	772	14,111
Stearns	*	*	*	*	0	18	435	146	117	163	553	716	17,310
Stevens	794	95	0	0	294	220	30	72	232	403	1,334	1,737	30,204
Swift	0	0	963	514	223	345	92	304	152	829	1,764	2,593	47,195
Todd	*	*	*	*	*	0	380	252	13	149	496	645	6,596
Traverse	*	*	*	*	*	71	0	339	198	180	428	608	17,057
Waseca	*	*	*	*	*	0	52	201	69	90	232	322	6,744
Wright	*	*	*	*	*	0	243	162	229	166	468	634	15,216
Yellow Medicine	*	*	*	*	*	224	0	0	73	88	209	297	7,721
Total	8,773	3,969	16,292	7,138	6,654	10,729	12,173	10,194	8,993				
Cumulative total	8,773	12,742	29,034	36,172	42,826	53,555	65,728	75,922	84,915	21,696	63,219	84,915	1,334,306

Source: Agricultural Stabilization and Conservation Service, Water Bank Program Status of Agreements for Minnesota Counties as of 30 May 1980.

* County was not eligible this year.

Map 5:

FWB Wetlands Payment



FISH AND WILDLIFE SERVICE EASEMENT AND ACQUISITION PROGRAM

The Fish and Wildlife Service acquires wetlands in 28 Minnesota counties. Most of the counties declared eligible by the Service for the acquisition program are in the study area and are displayed on Map 4. Portions of Todd and Morrison Counties, which lie on the fringe of the study area, are also eligible. The acquisition program is a "willing seller" program. Typically, land is acquired by fee-title purchase or purchase of a perpetual easement that forbids the draining, filling, burning, or leveling of the wetland. Terms of the easement are binding even if the land under easement is sold to another party.

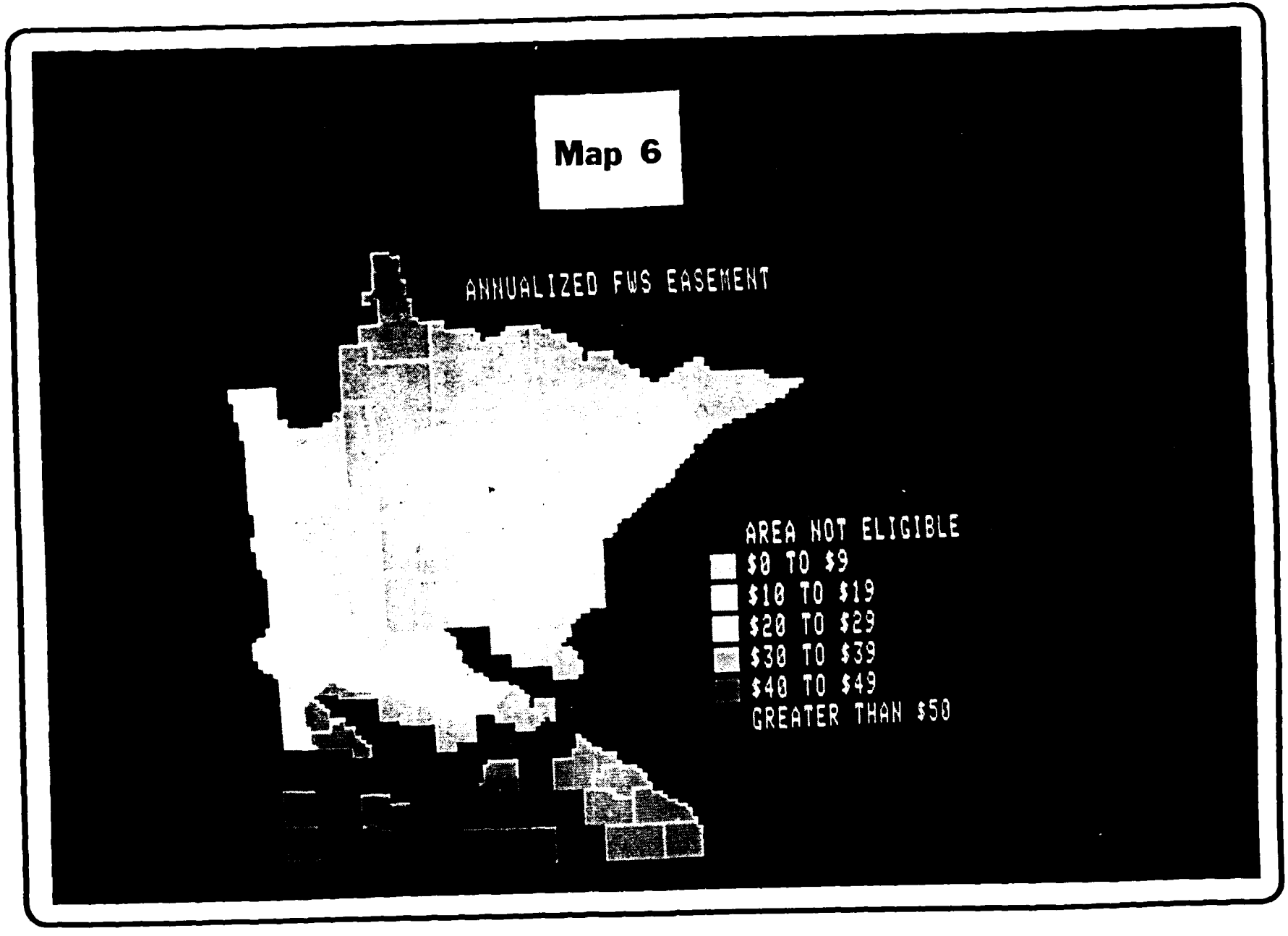
The Fish and Wildlife Service prefers to purchase in fee title those wetlands and adjacent uplands that are the most suitable for wildlife habitat and use easements to protect nearby wetlands for additional water area. The easement applies only to the wetland, not to uplands. To protect uplands necessary for proper waterfowl management, the FWB program allows for 10-year agreements on lands under Fish and Wildlife Service easement. The annual payment available through the FWB program for wetlands under Fish and Wildlife Service easement is $8 per acre, rather than $10 per acre. Upland payments are arranged according to the standard FWB formula.

The Fish and Wildlife Service is required by law to appraise lands proposed for purchase and easement. The appraisals must be reviewed and approved by experienced review appraisers. Payments are made at market value in a lump sum to the landowner. If a landowner agrees to sell outright or sell an easement for the fair market value amount estimated by the Fish and Wildlife Service appraisers, the local county board is asked to review and comment on the proposed transaction. Approval of the State Land Exchange Board is necessary to complete the transaction. A list by county of the number of acres acquired as of April 1980 in fee title or by easement is presented in the following table.

Fish and Wildlife Service easement and acquisition program: acreage enrolled by county in Minnesota as of April 1980

County	Fee title purchases (acres)			Easement purchases (wetland acres)
	Wetland	Adjacent to wetland	Total	
Becker	3,592	5,875	9,467	547
Big Stone	3,409	5,392	8,801	4,426
Clay	2,529	5,835	8,364	1,364
Cottonwood	265	745	1,010	0
Douglas	2,857	4,630	7,487	3,432
Faribault	0	0	0	0
Freeborn	100	138	238	15
Grant	3,228	4,690	7,918	1,214
Jackson	769	1,533	2,302	0
Kandiyohi	3,735	6,076	9,811	3,064
Lac qui Parle	840	1,618	2,458	457
Le Sueur	0	0	0	0
Mahnomen	1,663	3,127	4,790	4,287
McLeod	0	0	0	0
Meeker	279	529	808	276
Morrison	0	0	0	0
Norman	0	0	0	0
Otter Tail	5,638	10,580	16,218	6,809
Polk	2,743	5,154	7,897	677
Pope	4,322	7,933	12,255	5,456
Stearns	2,604	4,167	6,771	380
Stevens	2,619	4,678	7,297	507
Swift	2,338	3,697	6,035	471
Todd	108	271	379	16
Traverse	912	1,703	2,615	903
Wilkin	413	834	1,247	167
Wright	162	187	349	9
Yellow Medicine	32	38	70	17
Minnesota total	45,157	79,430	124,587	34,494

To compare the Fish and Wildlife Service payment level for easements with the amount offered by other programs or the amount of income possible from draining the wetland, the payment level should be expressed as an annual, per-acre amount. Because easement payments are set on a case-by-case basis and are made as a lump sum rather than an annual amount, the payments must be converted to annual per-acre terms. For this report, the lump sum easement payment is assumed to be set at 60 percent of the market value of the land. This rate has been used as a "rule of thumb" by Fish and Wildlife Service appraisers as a starting point in establishing easement payments.[5] The lump sum has been annualized at an interest rate of 9.2 percent, which was the average yield for long-term Government securities for 1979-80. The result, which is titled "Annualized FWS Easement," is displayed as Map 6.


Map 6
ANNUALIZED FWS EASEMENT
AREA NOT ELIGIBLE
$0 TO $9
$10 TO $19
$20 TO $29
$30 TO $39
$40 TO $49
GREATER THAN $50

STATE WATER BANK

A Minnesota State Water Bank (SWB) program was authorized by Minnesota Statutes, Section 105.392, as passed in March 1976 and amended in May 1979. This law declares the legislature's finding that it is in the public interest to preserve the State's wetlands to conserve surface waters, preserve wildlife habitat, reduce runoff, retain floodwaters, reduce stream sedimentation, contribute to subsurface moisture, enhance natural beauty, and promote comprehensive water management planning. Having recognized these wetland functions, the legislature authorized the Minnesota Department of Natural Resources (DNR) to establish and administer a program to complement the Federal Water Bank program.

The SWB program was intended to operate in conjunction with the Public Waters and Wetlands Inventory, Classification, and Permit program, also authorized in 1976 and amended in 1979 (Section 105.319). Under this law, the DNR must prepare a county-by-county inventory of and regulate all public waters and wetlands, as defined by the law. Wetlands are defined as Type 3, 4, and 5 wetlands. For the State to exercise permit authority, the wetlands must be more than 10 acres in unincorporated areas or more than 2 1/2 acres in incorporated areas. However, there is no minimum size for wetlands eligible for the SWB program. The program has been controversial and has had a slow start, but appears to be progressing better.

The law declares that drainage of wetlands, as they are defined above, is not allowed unless one of two conditions is met. The first condition is that the wetland will be replaced with a wetland of equal or greater public value. The second condition is that the State would fail to devise, within 60 days of receiving a permit application from a landowner, some method of indemnifying the landowner through any appropriate means, such as enrolling the wetland in the SWB program. In other words, the law requires the State to use a compensation scheme such as the SWB if it is to exercise its permit authority over drainage of privately owned wetlands.

As indicated here, the law appears to give the landowner flexibility in choosing an appropriate method of compensation. The law states that the landowner may choose the SWB payment, sell the wetland, or be indemnified through "any other appropriate means." If the sWB is chosen, a 10-year agreement will be signed with the landowner calling for annual payments at a specified level to the landowner. In turn, the landowner agrees not to drain, burn, fill, or otherwise destroy the wetland and promises to carry out any conservation plan for the land that is agreed upon with the DNR.

No geographical area of the State is necessarily excluded from the SWB program. However, not all Type 3, 4, or 5 wetlands are automatically eligible for the program. First, an applicant must demonstrate that drainage is lawful, feasible, and practical. In other words, the drainage must be physically possible and not unlawfully release water onto another party. Second, drainage would have to produce high quality cropland. Following the recommendations of the Soil Conservation Service, the DNR has devised a formula based on the number of growing season degree days and soil type to determine which wetlands would produce high quality cropland. Details on eligibility determination are given in the following table.

Eligibility determination for State Water Bank

1. Rating numbers are given for soil types as follows:

Rating value	Soil properties
1	Loamy or clayey mineral soils (loamy or clayey average particle size in the control section).
2	Deep organic soils (typic subgroups) and shallow organic soils with a loamy or clayey substratum (terric subgroups with loamy or clayey particle size).
3	Shallow organic soils with a sandy or gravelly substratum (terric subgroups with sandy or sandy skeletal particle size).
4	Sandy or gravelly mineral soils (aquents, aquepts, and aquolls with sandy or sandy skeletal average particle size in the control section).
5	Other soils (mostly soils with limnic materials dominating the control section).

2. Rating numbers are also given for growing degree days (GDD):

Rating value	Climate	General area
1	More than 4,400 GDD	Counties south of Interstate 94
2	3,400-4,400 GDD	Counties north of Interstate 94, excluding Arrowhead Region
4	Less than 3,400 GDD	Arrowhead Region (St. Louis, Cook, and Lake Counties)

3. To determine eligibility, multiply soil type rating number by GDD rating number. Land with a value of four or less is considered high quality cropland.

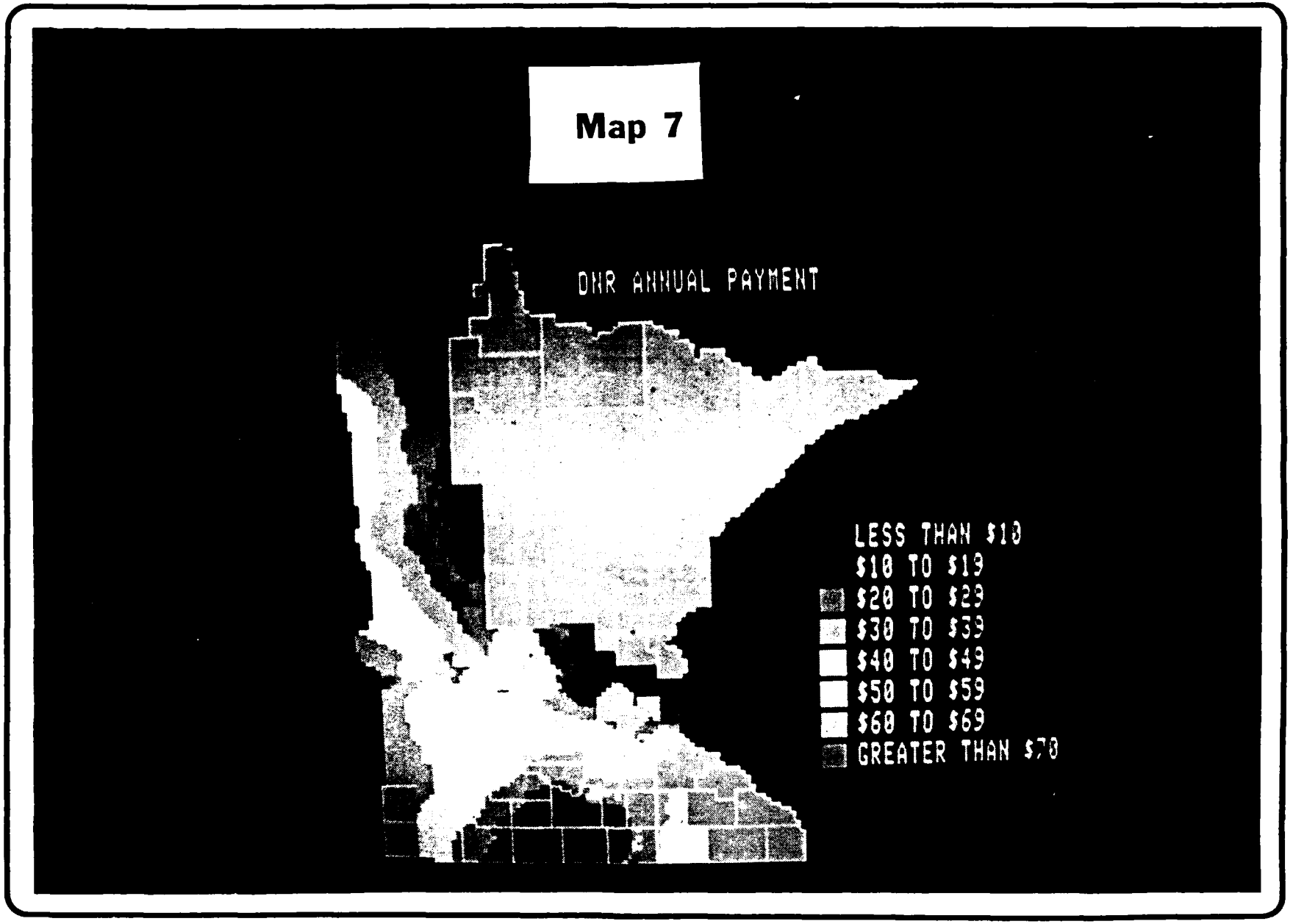
SOURCE: Minnesota Department of Natural Resources.

DNR regulations set SWB annual payments at 5 percent of the fair market value of land (i.e., value as agricultural cropland less the cost of drainage).[6] Payments were estimated using cropland rental data and information on drainage costs appearing in Appendix A. The result is displayed on Map 7, "DNR Annual Payment." As the map shows, payment levels set according to the regulations range in the study area from less than $10 to more than $70.

STATE-PAID WETLANDS PROPERTY TAX CREDIT

A new incentive to preserve wetlands is provided by the State-paid wetlands property tax credit, which goes into effect for taxes levied in 1980 and payable in 1981. The credit was established by the Minnesota Legislature in 1979 and is codified in Sections 272.021 and 273.115 of the Statutes of Minnesota. The law states that wetlands are exempt from property taxes, establishes a credit to be paid to wetland owners, and sets up a procedure for reimbursing counties for lost revenues.

Under this law, wetlands are defined as land that is mostly under water, produces little if any income, is preserved in its natural condition, and could be drained to be made suitable for crop or livestock production. The credit is available if drainage is "lawful, feasible, and practical" and if the landowner agrees not to drain the wetland during the tax year. The Minnesota Department of Revenue has interpreted the "lawful, feasible, and practical" clause to include all wetlands in counties where drainage is a common practice, except where the taxed individual does not have legal title. Lands enrolled in the State or Federal Water Bank or under easement to the Fish and Wildlife Service qualify for the credit under this interpretation, because the landowner retains legal title with each of these programs. Assessors in all the counties in the study are are expected to consider drainage a common practice. Thus, practically all Type 3, 4, and 5 wetlands in the study area will qualify for the credit. Because interpretation of what is and is not a wetland will vary from assessor to assessor, Type 2 wetlands might be considered eligible in some counties.


Map 7
DNR ANNUAL PAYMENT
LESS THAN $10
$10 TO $19
$20 TO $29
$30 TO $39
$40 TO $49
$50 TO $59
$60 TO $69
GREATER THAN $70

The credit amounts to 0.75 percent of the average estimated market value per acre of tillable land in the city or township where the wetland is located multiplied by the number of wetland acres. A farmer with a 10-acre marsh in a township with an average market value of $800 per acre of tillable land could receive a tax credit of $60 (10 acres x $800 per acre x 0.0075). The sample property tax statement in the following table shows how the wetlands tax credit will be noted on the tax bill. It appears on line 9B as a reduction from gross taxes.

SAMPLE PROPERTY TAX STATEMENT

_____County, _____Township Parcel number:_____

School district XXX

Estimated market value: $_____ Limited market value: $_____ Assessed value: $_____

YOU MAY BE ENTITLED TO A REFUND.

USE THESE AMOUNTS

when you fill out the property tax refund form M-1PR:

1. Qualifying tax amount $_____
2. State paid homestead credit $_____

Name

Street Address

City

TOTAL 12. AMOUNT PAYABLE	FIRST HALF DUE May 31	SECOND HALF DUE OCT. 31
$_____	$_____	$_____

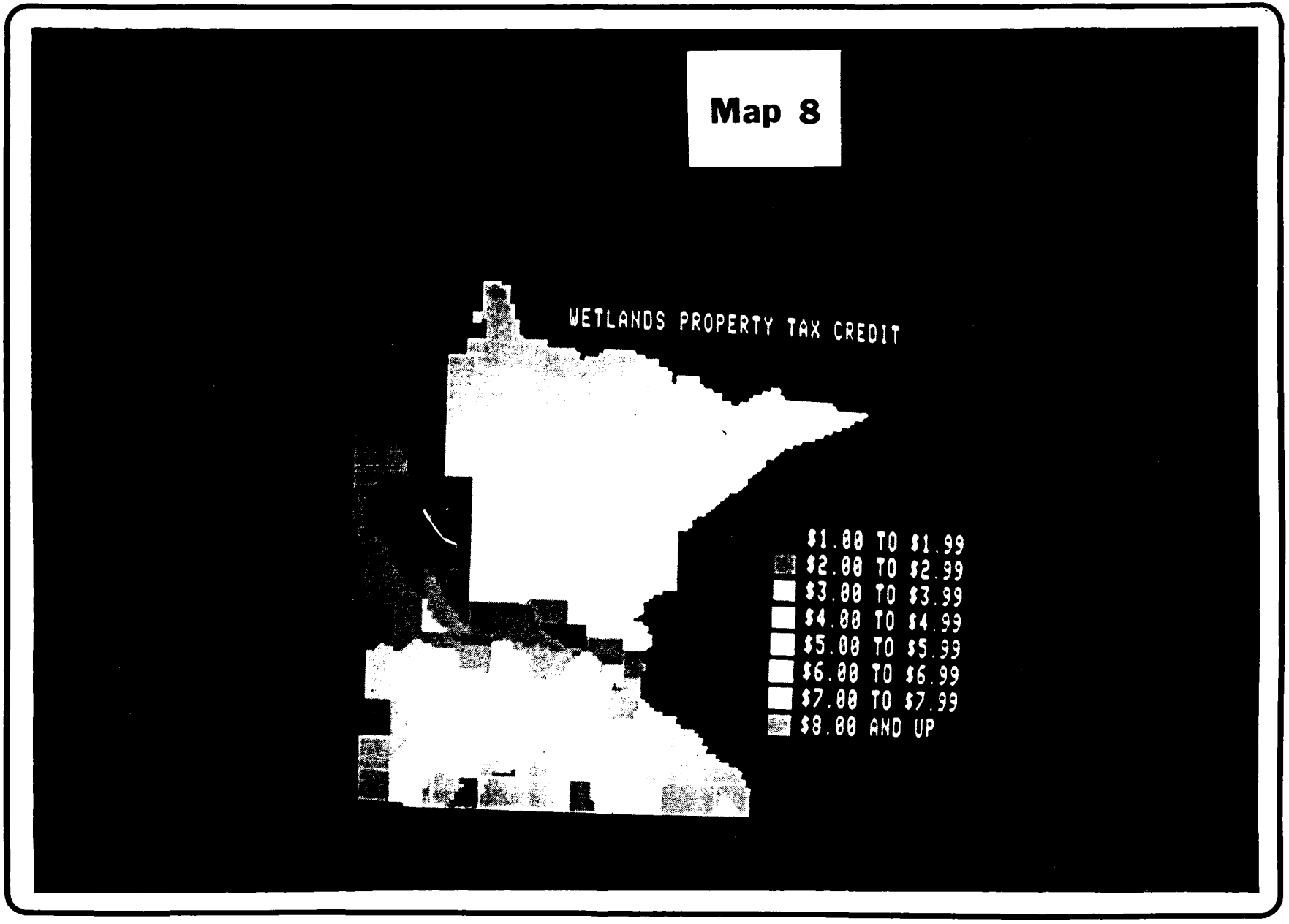
Special Assessments Code	Amount

GROSS TAX DISTRIBUTION

3. State	$ 0
4. County	
5. Township or city	
6. School district	
7. Other	
A. Watershed	
B.	
C.	
8. Total gross tax	
9. Reductions	
A. State school agricultural credit	
B. Wetlands credit	
C. State paid homestead credit	
10. Total tax	
11. Special assessment	

Before the law went into effect, wetlands were assessed differently in the various counties. The assessor in at least one county had already been exempting wetlands from taxes. Others assessed wetlands at various rates. Because only the total assessed value for each parcel of land appears on the property tax statement (refer to the sample statement), it was difficult for a landowner to know how wetlands were being assessed, because the wetlands may have been only a small part of the parcel. Leitch and Danielson discovered in their 1979 survey of farmers in Douglas, Pope, and Otter Tail Counties that 73 percent did not know how their wetlands were assessed.[7] This situation should change with the tax exemption and credit.

Because data were not immediately available on market values from county assessors, the following steps were followed to estimate the amount of the credit. First, cropland rental rates (shown on Map 3) were converted to sales value using a 4-percent capitalization factor for southern Minnesota and the Red River Valley and a 4 1/2-percent factor for other areas, as advised by Anthony et al.[8] The resulting figure was increased by 17 percent to bring it to 1980 land price levels. (Henneberry and Raup report 17 percent as the average annual increase in Minnesota cropland value for the 1978-1979 period and also for the 1969-1979 period.[9] Data are not yet available for 1979-1980 increases.) Sales values were converted to assessors' market values using data provided by the Minnesota Department of Revenue on the relationship of sales value to market value for each county.[10] Finally, market values were multiplied by 0.75 percent to arrive at the estimated annual tax credit amount per wetland acre, which is displayed on Map 8. In general, the credit is highest in the high land value regions of southern Minnesota (upwards of $8 per acre per year) and lowest in the eastern fringes of the Red River basin ($1.00 to $1.99). Irregularities in the pattern are due to differing ratios of sales value to market value in the counties, which result from slightly different assessment practices.


Map 8
WETLANDS PROPERTY TAX CREDIT
$1.00 TO $1.99
$2.00 TO $2.99
$3.00 TO $3.99
$4.00 TO $4.99
$5.00 TO $5.99
$6.00 TO $6.99
$7.00 TO $7.99
$8.00 AND UP

SUMMARY

The Federal Water Bank, Fish and Wildlife Service easement and acquisition program, State Water Bank, and State-paid wetlands property tax credit programs differ considerably. The two water bank programs offer annual payments for a 10-year period to farmers who agree not to drain, while the Fish and Wildlife Service offers a lump-sum payment for outright acquisition or a perpetual easement forbidding drainage. The tax credit offers an indirect payment through reduction of a farmer's property taxes in return for a promise not to drain and is renewable on a year-to-year basis. The amount of money available through each program varies a great deal.

This completes the discussion of the four government programs designed to encourage preservation of wetlands. The next task of this report is to review the net returns available to a farmer through wetland drainage.

NET RETURNS FROM WETLAND DRAINAGE

The potential economic returns to a farmer from conversion of a wetland to cropland can be calculated and expressed in a number of ways. The partial budget technique is the method chosen for calculation for this study. It has already been discussed. Net returns will be expressed on an annual, per-acre basis, before and after taxes.

The partial budget method evaluates changes in gross income and total costs. These changes have various components, which can be divided into two sets. The first set could be called market forces and includes gross returns, production costs, and drainage costs. The estimated effect of each of these components is analyzed in detail in Appendix A. The second set could be called tax forces and includes property tax and income tax considerations. These components will be discussed in the following sections.

It is typical for businesses to express net returns on both a before- and after-tax basis. This report will follow that example. The estimated annual net income per acre with wetland drainage will be given before all taxes (Net Returns 1), after property taxes (Net Returns 2), and after property and income taxes (Net Net Returns).

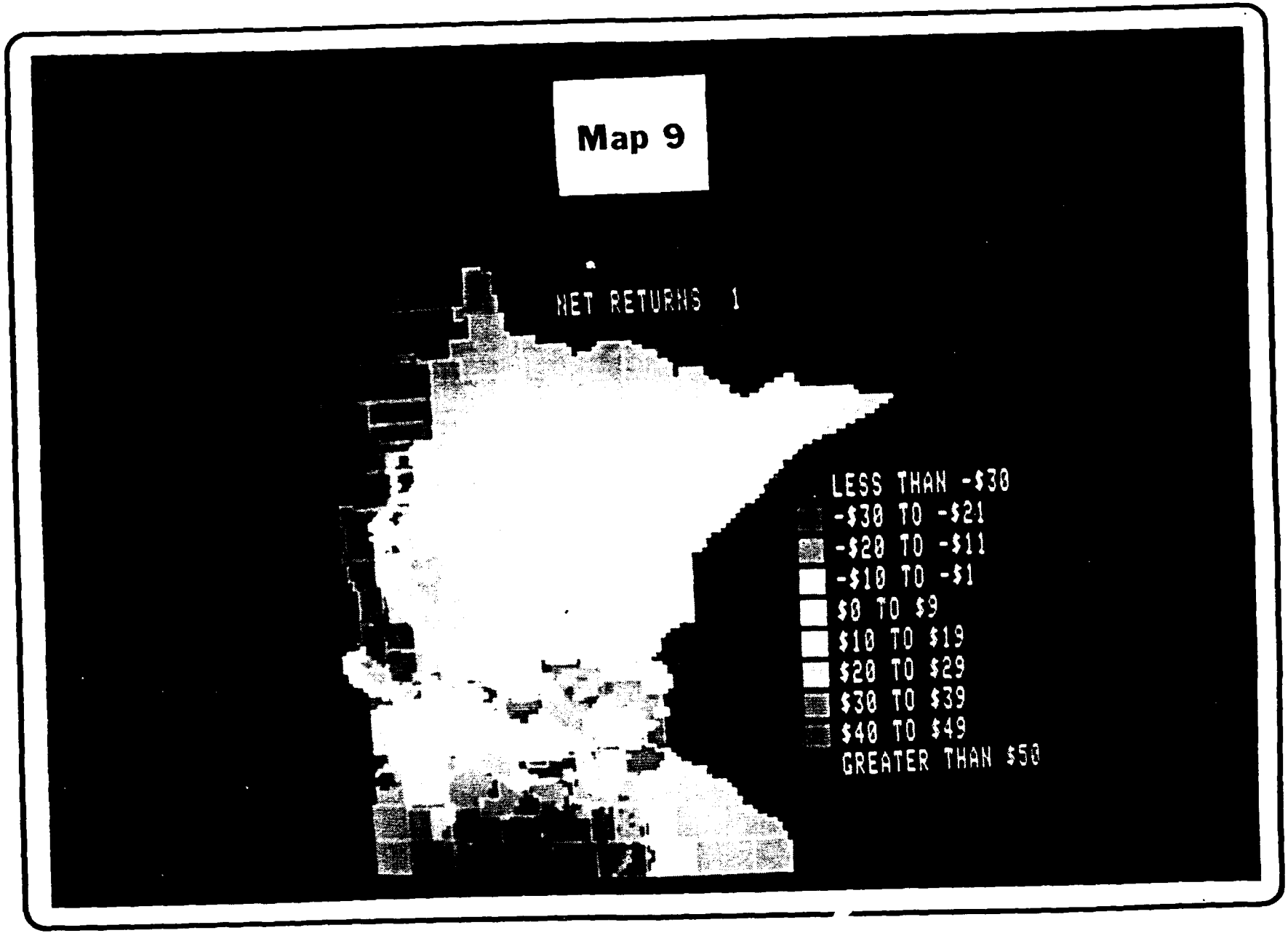
Each of these income figures has been computed for the various parts of the study region using the MLMIS by combining the components of net returns on a 5-square-kilometer grid cell basis. Appendix A describes the "map overlay" technique that was used to derive these combinations and also presents the assumptions used for the analysis. Maps will be presented to show the estimated regional variation of net returns. The results presented in this section make it possible to compare the returns available through the four compensation and incentive programs that have been analyzed, per year and per acre of wetland, to the returns that may be available if the wetland were drained and cultivated.

NET RETURNS BEFORE ALL TAXES (NET RETURNS 1)

Net returns before all taxes (Net Returns 1) are defined as annualized gross returns minus annual production cost minus annualized drainage cost. Each of the components of Net Returns 1 has been converted to an annual per-acre value as appropriate using an interest rate of 12 percent. The interest rate and the calculation of Net Returns 1 are discussed in Appendix A.

The results of the calculations, as performed on the 5-square-kilometer grid cell basis using the MLMIS, are shown in Map 9. The estimated net returns from wetland drainage, as shown on this map, range from -$11 to -$30 in parts of the northern Twin Cities metropolitan area to more than +$50 in portions of south-central Minnesota and the Red River Valley. Values in the "prairie pothole" region of the west-central part of the State, including counties such as Otter Tail, Douglas, and Pope, vary considerably, with a high of +$29 and a low of -$10. (Where the net return from drainage is shown as a negative value, a farmer is estimated to lose money on an annual basis if he drains a wetland.)

One way to describe the region where Net Returns 1 is lowest (say, from -$30 to +$9) would be to call it a "transition zone". In one area (along the northern or eastern boundary of the study area), it marks the


Map 9
NET RETURNS 1
LESS THAN -$30
-$30 TO -$21
-$20 TO -$11
-$10 TO -$1
$0 TO $9
$10 TO $19
$20 TO $29
$30 TO $39
$40 TO $49
GREATER THAN $50

transition from a prairie to a forest soil. In another area (including Lincoln, Yellow Medicine, Lac qui Parle, Chippewa, Swift, and Kandiyohi Counties), it lies between the soybean/corn region and the wheat/barley/sunflower region. This "transition zone" is characterized by relatively lower productivity and/or relatively higher drainage costs than those in adjacent zones.

Analysis of Net Returns 1 revealed that the most influential component of net returns is gross returns, which are determined by cropping patterns, yields, and crop prices. While the former two determinants shift over time, crop prices are by far the most volatile. Some crop prices increased more than 50 percent in 1980 alone. Hence, crop prices are both a sensitive and a highly changeable component of the net returns of drainage. Significantly higher crop prices could mean "fencepost to fencepost" cultivation and a higher rate of wetland conversion than that seen today.

NET RETURNS AFTER PROPERTY TAX (NET RETURNS 2)

Net returns after property tax (Net Returns 2) are defined as Net Returns 1 minus forgone wetlands property tax credit minus additional property tax assessment. As this formula indicates, property tax considerations affect net returns in two ways. First, if a farmer chooses to drain, he will immediately have to forgo the wetlands tax credit, which would have been granted to him in near-automatic fashion as long as drainage had not taken place. In addition, the drained land will be subject to property taxes. This land will be assessed as cropland once it is cultivated. The property tax bill on this land can significantly affect the economics of drainage of wetlands.

The additional property tax assessment has been calculated using a procedure similar to that used to estimate the wetlands property tax credit. The cropland rental rate data, capitalization factors of 4 or 4 1/2 percent, and Minnesota Department of Revenue data on sales-to-market-value ratios were used. In addition, the Department of Revenue supplied data on the effective tax rate for each county, after adjustments for homestead, agricultural, and other tax credits. This information was

used to estimate the tax that would be assessed on an acre of drained land. Map 10 displays the additional property tax assessment. The additional assessment ranges from about $4 to $16 per acre per year. Land value is the principal determinant, but assessment practices do lead to occasional differences among counties with similar land values.

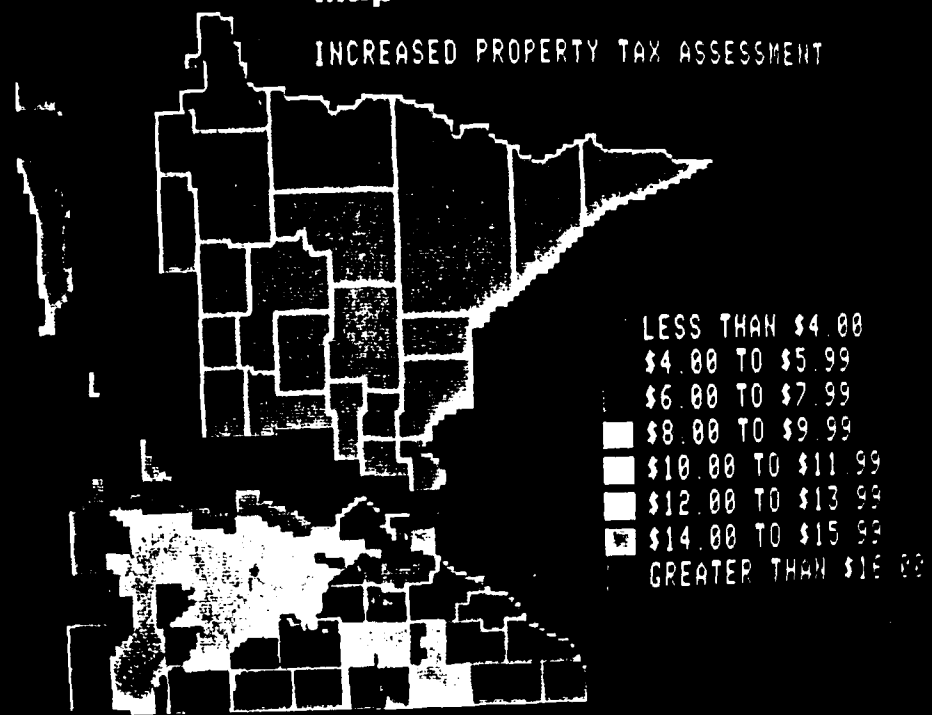
Map 11 combines the forgone wetlands tax credit shown on Map 8 and the additional assessment shown on Map 10. Once again, the basic pattern is similar to that of the cropland rental rate map. Clearly, the property tax factor is significant. The forgone credit and additional property tax paid by a farmer could amount to as much as $22 per drained acre per year. This cost of drainage will have a measurable effect on the net returns of drainage.

The effect on drainage returns is shown on Map 12, which displays net returns after property tax (Net Returns 2). The property tax factor increases the total area where drainage returns are negative (infeasible drainage). Few areas show up as having net returns greater than $30 to $39 per acre per year. The areas that were highest or lowest for Net Returns 1 are still highest or lowest for Net Returns 2. The overall pattern has not changed appreciably. However, the effect of property tax on the amount a farmer can expect to earn from drained wetland is apparent.

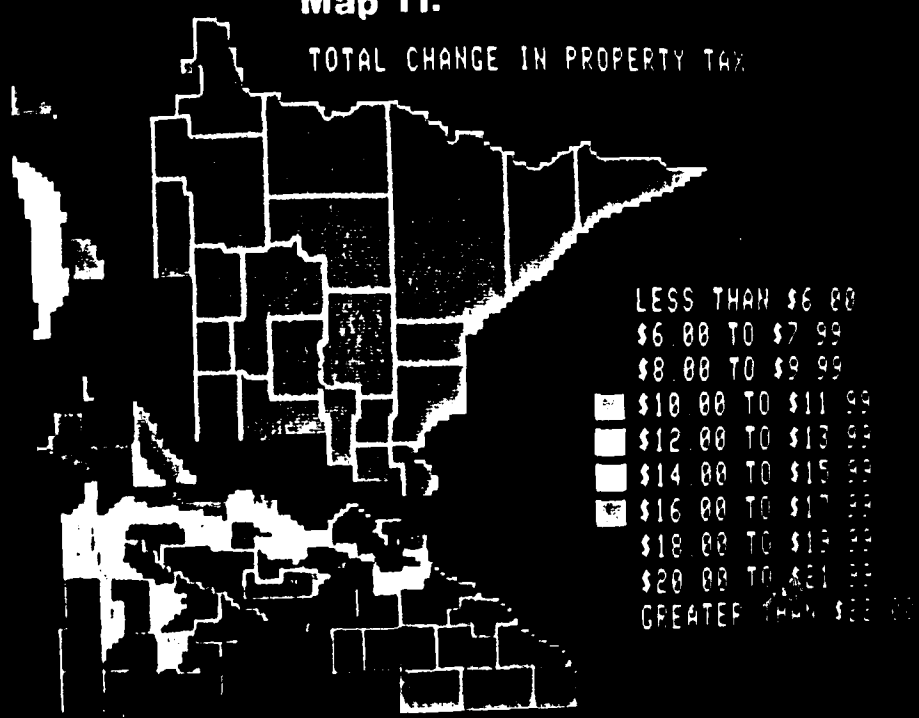
NET RETURNS AFTER ALL TAXES (NET NET RETURNS)

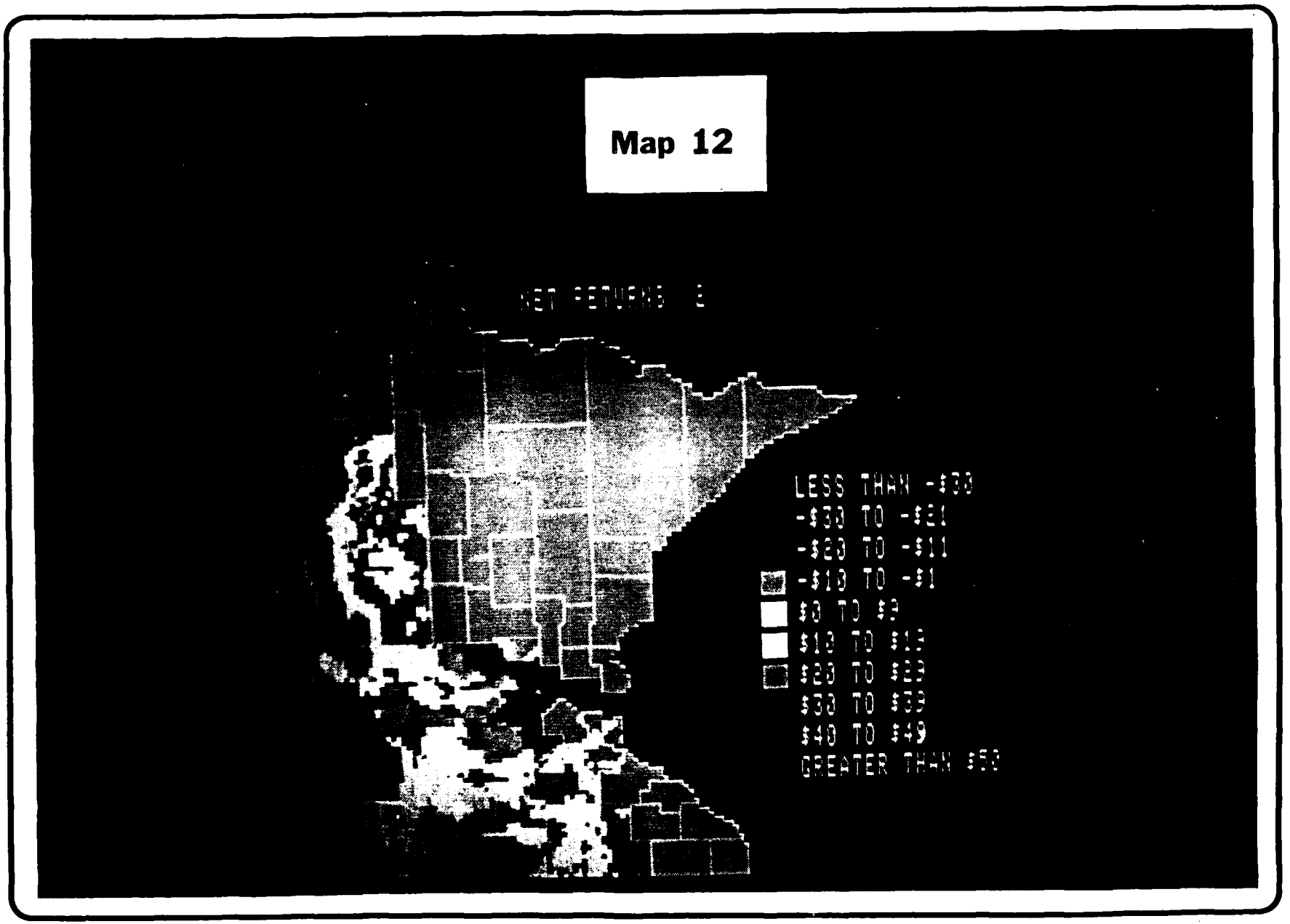
Net returns after all taxes (Net Net Returns) are defined as Net Returns 2 minus additional income tax liability plus investment tax credit amount. Net Net Returns are the result of consideration of the effects of State, Federal, and Social Security income tax on the increment of income generated by converting wetlands to cropland. Also considered is the investment tax credit, which is available for tile drainage investment and can be used to offset other Federal income tax liabilities.

Map 10:


INCREASED PROPERTY TAX ASSESSMENT
LESS THAN $4.00
$4.00 TO $5.99
$6.00 TO $7.99
$8.00 TO $9.99
$10.00 TO $11.99
$12.00 TO $13.99
$14.00 TO $15.99
GREATER THAN $16.00

Map 11:


TOTAL CHANGE IN PROPERTY TAX
LESS THAN $6.00
$6.00 TO $7.99
$8.00 TO $9.99
$10.00 TO $11.99
$12.00 TO $13.99
$14.00 TO $15.99
$16.00 TO $17.99
$18.00 TO $19.99
$20.00 TO $21.99
GREATER THAN $22.00

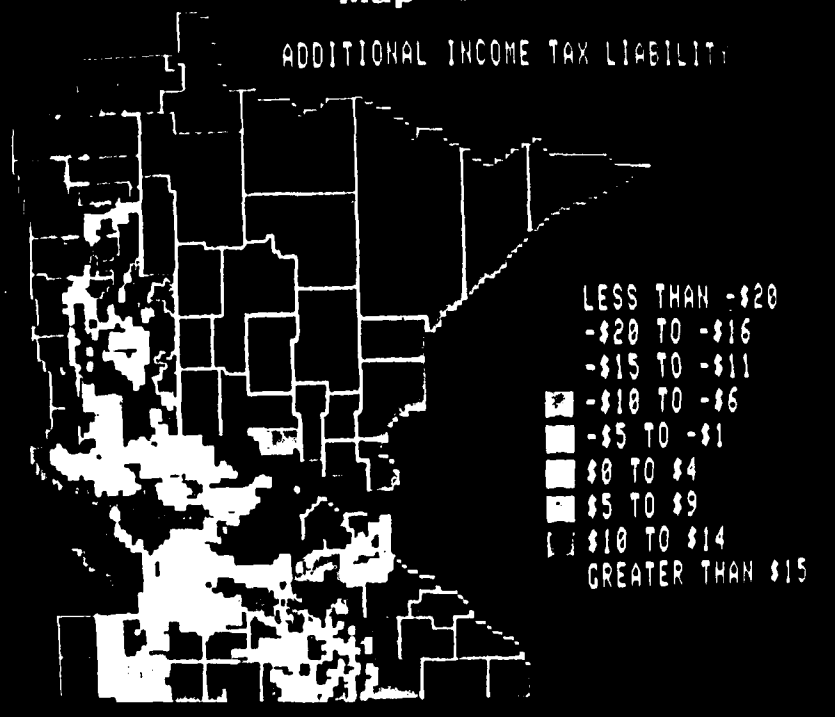

Map 12
LESS THAN -$30
-$30 TO -$21
-$20 TO -$11
-$10 TO -$1
$0 TO $9
$10 TO $19
$20 TO $29
$30 TO $39
$40 TO $49

The first step in determining a method for calculating additional income tax liability is to choose an appropriate marginal tax bracket for farmers involved in drainage. A 40-percent marginal tax bracket appears to apply to many farmers, but many farmers will have no tax liabilities and will, therefore, be in a 0-percent marginal tax bracket. This point is discussed further in Appendix A. Analysis will proceed using the assumption of a 40-percent marginal tax bracket, but it should be remembered that the income tax factor will affect some farmers not at all. For those farmers, Net Net Returns would be equal to Net Returns 2.

Even after an assumption has been chosen on the marginal tax bracket, calculation of additional income tax liability is not straightforward. Performing this computation required perusal of income tax laws and regulations on allowable depreciation for tax purposes. It was found, for example, that tax laws allow a farmer to write off any ditching costs in the year they are incurred. This is in spite of the ditch's ability to function for an economic life of perpetuity, with proper maintenance. Also, 20 percent of any investment in drain tile may be depreciated immediately. The remaining 80 percent will be assumed to be depreciated on a straight-line basis over a 20-year life. (Depreciation is simply an expense item that is deducted from gross income in computing net taxable income.)

These liberal depreciation policies reduce income tax liability. For those areas with positive returns from drainage, as computed for tax purposes, the income tax can reduce net income per year per acre of drained wetland by up to $15 (see Map 13). For areas where taxable income on drained land is negative, the additional tax liability is negative, as the map also shows. What this means is that, in certain parts of the State, a farmer may be able to reduce his overall tax liability by investing in a project with a poor return. Because of the idiosyncrasies of the tax law, the reduction in tax liability is occasionally great enough to offset the before-tax loss on the investment. Hence, a proposition which had a negative net return before taxes may have a positive return after taxes.

Map 13:


ADDITIONAL INCOME TAX LIABILITY
LESS THAN -$20
-$20 TO -$16
-$15 TO -$11
-$10 TO -$6
-$5 TO -$1
$0 TO $4
$5 TO $9
$10 TO $14
GREATER THAN $15

Map 14:


INVESTMENT TAX CREDIT AMOUNT
$0 PER ACRE
$5 PER ACRE
$6 PER ACRE

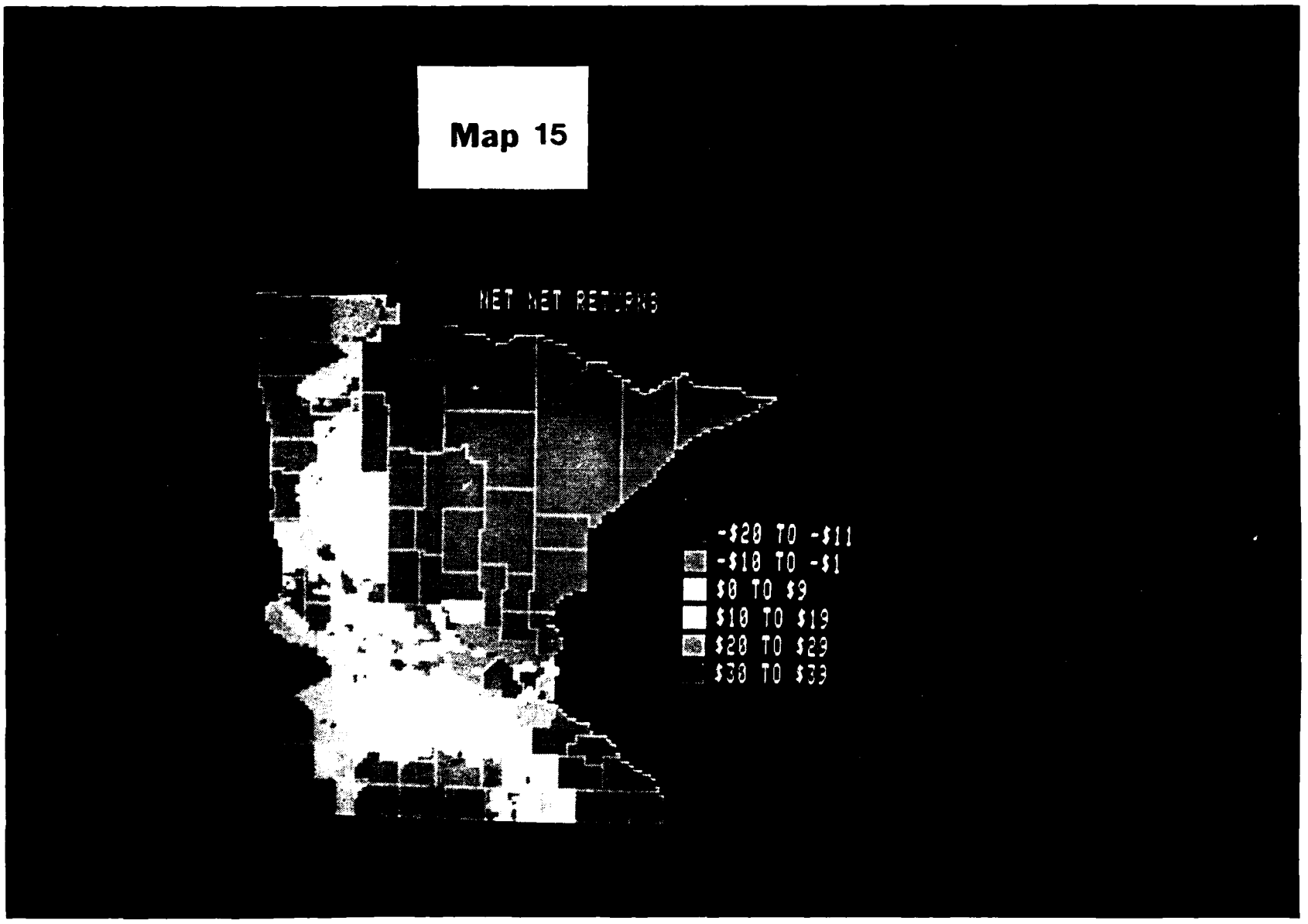
The second income tax factor that must be considered is the investment tax credit. A credit of 10 percent is available on tile drainage investment. What this means is that farmers can reduce their tax payment by 10 percent of the cost of tile. This report makes the simplifying assumption that tile will be used only in southern Minnesota for field drainage and shows an annual per-acre equivalent of $5 to $6 for the credit in this region. In the northwest region, where both ditches and tile are used to drain surface water on random wetlands, it is assumed that the credit will not be available. (Under Internal Revenue Service regulations, drainage ditch work does not quality for the credit.) The investment tax credit amount is shown on Map 14.

Map 15 displays net returns after all taxes or Net Net Returns. The most striking aspect of this map is the condensation of the range of Net Net Returns. The income tax has a clear tendency toward equalization of the net returns from drainage. The total range is principally between -$10 and $30 per year per drained acre. The pattern is basically the same as Net Returns 2, but the range in values is not as wide. Net Net Returns are highest in south-central Minnesota and the Red River Valley and lowest in the northern Twin Cities metropolitan area and a portion of western Minnesota (Lincoln, Yellow Medicine, and Lac qui Parle Counties). Values in the prairie pothole region are mainly in the $0 to $20 range.

Thus, the effect of income tax is much different from that of property tax. The latter reduces the net returns from drainage for all parts of the State, but the former can decrease or increase drainage returns. The income tax can subsidize losses as well as reduce gains. This means that net returns after all taxes are rather uniform through much of the State.

SUMMARY

This section has displayed the estimated net returns from converting wetland to cropland. This dollar amount was calculated using the partial budget method and is expressed on a per-year, per-acre basis. Also described in this section was the effect of property tax and income tax on drainage returns. These taxes each have a sizable effect on the net returns of drainage, but, while property tax always reduces the net return, income tax can increase the net return (or reduce the severity of a net loss). Net returns after all taxes, or "Net Net Returns" vary from -$10 to +$30 per year per acre through most of Minnesota.


Map 15
NET NET RETURNS
-$20 TO -$11
-$10 TO -$1
$0 TO $9
$10 TO $19
$20 TO $29
$30 TO $39

EVALUATION OF COMPENSATION AND INCENTIVE PROGRAMS

This section compares the dollar amounts available through the four compensation and incentives programs described earlier with the net returns estimated to be available through wetland drainage. The comparison is one test of the adequacy of these wetland preservation programs. While a farmer will probably not make a decision on draining solely on economic grounds, he will be less likely to drain if annual government payments through preservation programs exceed the amount available through drainage. The analysis that follows will show the areas in the agricultural regions of Minnesota where the government payment level is greater than the net returns from drainage and those areas where it is not as great.

Throughout this section, it is assumed that the wetland property tax exemption and credit will be received by all farmers who do not drain their wetlands. If a farmer drains, the exemption and credit are lost, and analysis of net drainage returns includes this loss. Therefore, the comparison of the compensation and incentive payments to net returns assumes receipt of the property tax exemption and credit in addition to any payment from the government programs.

Comparison will be made on both a before- and after-income-tax basis, with one exception. The exception is the case of Fish and Wildlife Service easement payments. These payments are typically reported for income taxes as a capital gain, and tax treatment will depend on the original purchase price of the land. Hence, generalized analysis of the income tax effect on the easement is not possible, and only before-income-tax analysis will be presented. Before- and after-income-tax analysis of the adequacy of the other programs is possible, however, and results of each analysis will be shown. Where maps are labeled "1" or "2", the "1" map shows before-income-tax analysis, and the "2" map shows after-income-tax analysis.

Comparisons are made on both bases because income tax applies to government payments as well as conventional crop income. It may seem odd that the Federal and State governments are giving with one hand and taking away with another, but this tax system is not without its justification. The main rationale would be that all income should be taxed regardless of the source so that government benefits might tend to be directed most strongly to those of lesser means.

One point that should be mentioned is that tax management of the income from crop production is much more flexible than for government payments. This is because crops can be stored from year to year and sold to take advantage of good crop prices or good tax breaks. Government payments, on the other hand, cannot be stored. Therefore, it might be possible for a farmer to pay less tax on income from crop sales than from wetland preservation programs. Nevertheless, the method adopted in analyzing income tax for this report is felt to apply to the general case.

Another point is that adequacy can mean a number of different things. To one person, adequacy might mean a payment level that would lead to the greatest number of wetland acres enrolled given a total budget limit. To another, it might mean payments that would acquire the best wetlands - choosing for quality rather than quantity. For this report, however, adequate simply means a payment level that exceeds the net return from drainage.

The adequacy of Federal Water Bank payments, Fish and Wildlife Service easements, State Water Bank payments, and the wetlands property tax credit will now be discussed.

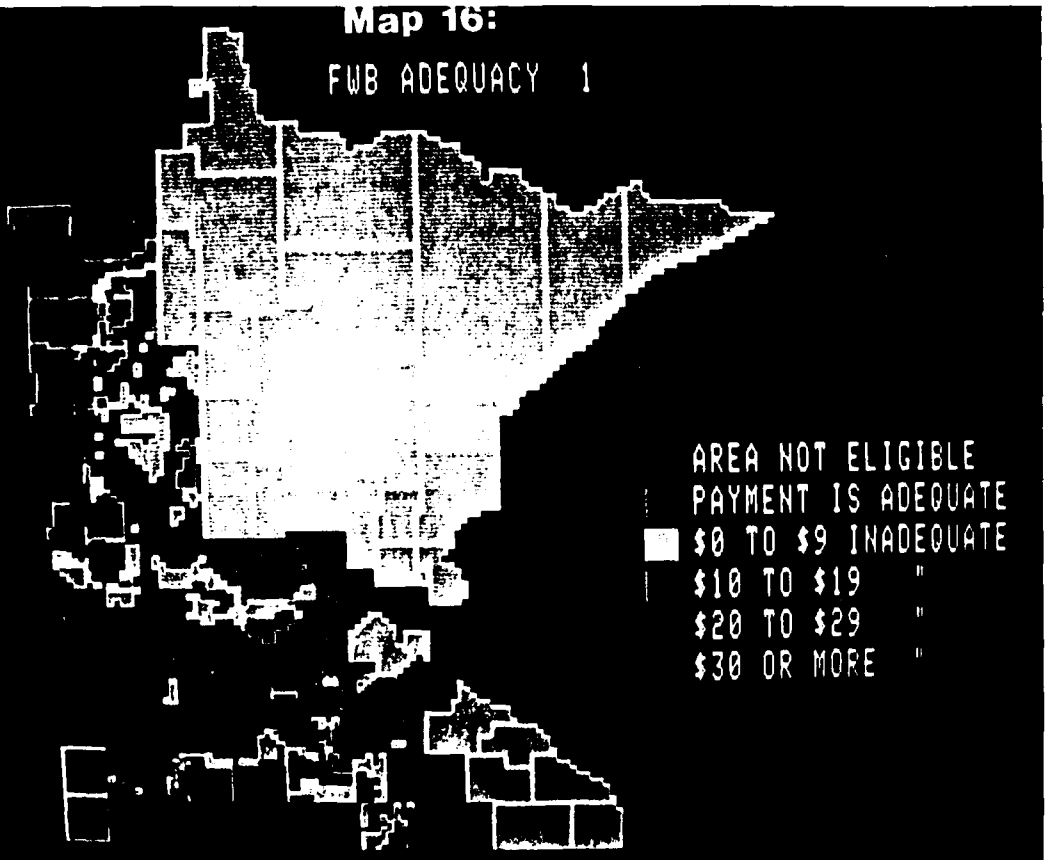
FEDERAL WATER BANK ADEQUACY

Before-Income-Tax Analysis

Map 16, "FWB Adequacy 1," subtracts the annual per-acre net returns before income tax (Map 12, "Net Returns 2") from the $10 per acre Federal Water Bank annual payment that is available in eligible counties (Map 5, "FWB Wetlands Payment"). Those eligible areas for which the Federal Water Bank payment exceeds Net Returns 2 are labeled "Payment is adequate." The map also shows how much the Federal Water Bank amount falls short of before-tax drainage returns in other eligible areas.

The map indicates that the $10-per-acre payment is greater than Net Returns 2 within a horizontal band west of the Twin Cities and in scattered areas in the eastern portion of the Red River basin. When analyzed on a before-tax basis, the payment appears to be more than $20 inadequate in much of the Red River Valley and portions of Cottonwood, Blue Earth, and Waseca Counties in south-central Minnesota.

Map 16:


FWB ADEQUACY 1
AREA NOT ELIGIBLE
PAYMENT IS ADEQUATE
$0 TO $9 INADEQUATE
$10 TO $19 "
$20 TO $29 "
$30 OR MORE "

Map 17:


FWB ADEQUACY 2
AREA NOT ELIGIBLE
PAYMENT IS ADEQUATE
$0 TO $9 INADEQUATE
$10 TO $19 "
$20 TO $29 "

After-Income-Tax Analysis

Map 17, "FWB Adequacy 2," makes the same kind of calculation as Map 16, but it makes comparisons on an after-income-tax basis. The income tax affects net returns, as was seen in Map 15, and it affects the Federal Water Bank payment as well. Most payments received by farmers under this Federal program are taxable. An exception is cost-sharing payments related to conservation programs. Cost-sharing payments by the Agricultural Stabilization and Conservation Service to farmers for carrying out a conservation plan (e.g., plantings to increase wildlife habitat) are not subject to income tax, but rental payments through the Federal Water Bank program are taxable.

It is assumed, once again, that farmers are in a 40-percent marginal tax bracket. This means that State, Federal, and Social Security income taxes are assumed to reduce the $10 per acre Federal Water Bank payment to $6 per acre. Net Net Returns (Map 15) are subtracted from $6 to derive Map 17, "FWB Adequacy 2."

The "payment is adequate" area on this map is not as large as that on Map 16. The reason is that taxes take a proportionately larger amount of the government payment than of drainage returns. This is because of liberal depreciation policies and the investment tax credit.

The Federal Water Bank payment appears adequate or $0 to $9 inadequate through the "transition zones" between prairie and forest soils and between the soybean/corn and wheat/barley/sunflower regions. It appears to be $10 to $19 insufficient per acre and per year in the Red River Valley and the south-central part of the State. In portions of the latter two areas, it is as much as $29 insufficient. The payment would have to be raised significantly before it would be adequate.

Discussion

When analyzed after taxes, Federal Water Bank payments appear to be less in many areas of Minnesota than the net return expected with conversion of wetland to cropland. Payment levels would have to increase

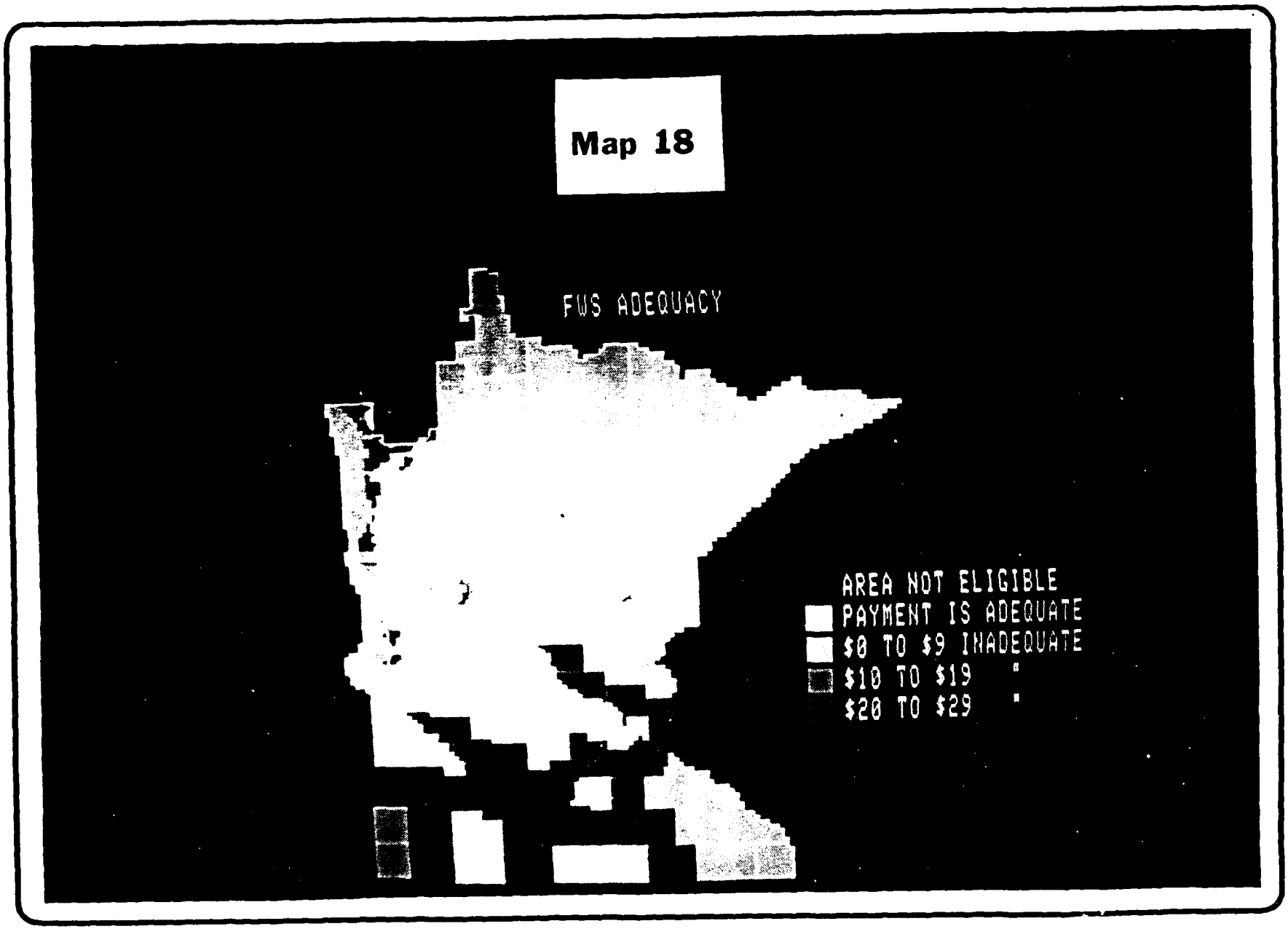
substantially to alter this situation. However, it would be unwise to conclude that the payments should be increased in any particular areas. The Federal Water Bank program in Minnesota operates under a budgetary restraint and, in 1980, reached its authorized limit for new agreements early in the year. While a higher payment might prove attractive to farmers in south-central or Red River Valley counties, it could also limit the total number of acres that could be enrolled in the program. Thus, while analysis indicates that the payments will not be high enough for all farmers, they are high enough to result in complete expenditure of available funds. In at least one sense, therefore, the program must be considered successful.

FISH AND WILDLIFE SERVICE EASEMENT ADEQUACY

An evaluation of the adequacy of the annualized amount available through the Fish and Wildlife Service easement program is shown on Map 18, "FWS Adequacy." Net returns before taxes (Map 12) were subtracted from the estimated easement payment (Map 6) to derive Map 18.

This map shows that payments are adequate through most of the eligible area. The one major exception is the Red River Valley, but the insufficiency does not appear to be extreme. Through the prairie pothole region (Otter Tail, Douglas, and Pope Counties, among others), the payment is adequate. The Fish and Wildlife Service easements appear to be designed fairly.

Success of this "willing seller" program of the Fish and Wildlife Service seems to be impaired not by an inadequate payment level but by reluctance of farmers to sell a perpetual easement, negative feeling toward the Fish and Wildlife Service, and fear of weed problems. Some review of payments offered in the Red River Valley might be called for by the analysis. However, it seems that the efforts of the Fish and Wildlife Service should be directed principally toward public education and relations and in selling the idea of perpetual easements. In addition, the Fish and Wildlife Service can continue to try to monitor its success rates in making agreements with those who express initial interest and make appropriate adjustments as the "market" for easements changes.


Map 18
FWS ADEQUACY
AREA NOT ELIGIBLE
PAYMENT IS ADEQUATE
$0 TO $9 INADEQUATE
$10 TO $19 "
$20 TO $29 "

Of course, future success of the program will depend on the support of policy makers in Washington, both in the executive branch and Congress. Present payment levels appear adequate; whether this will remain true with a new administration remains to be seen.

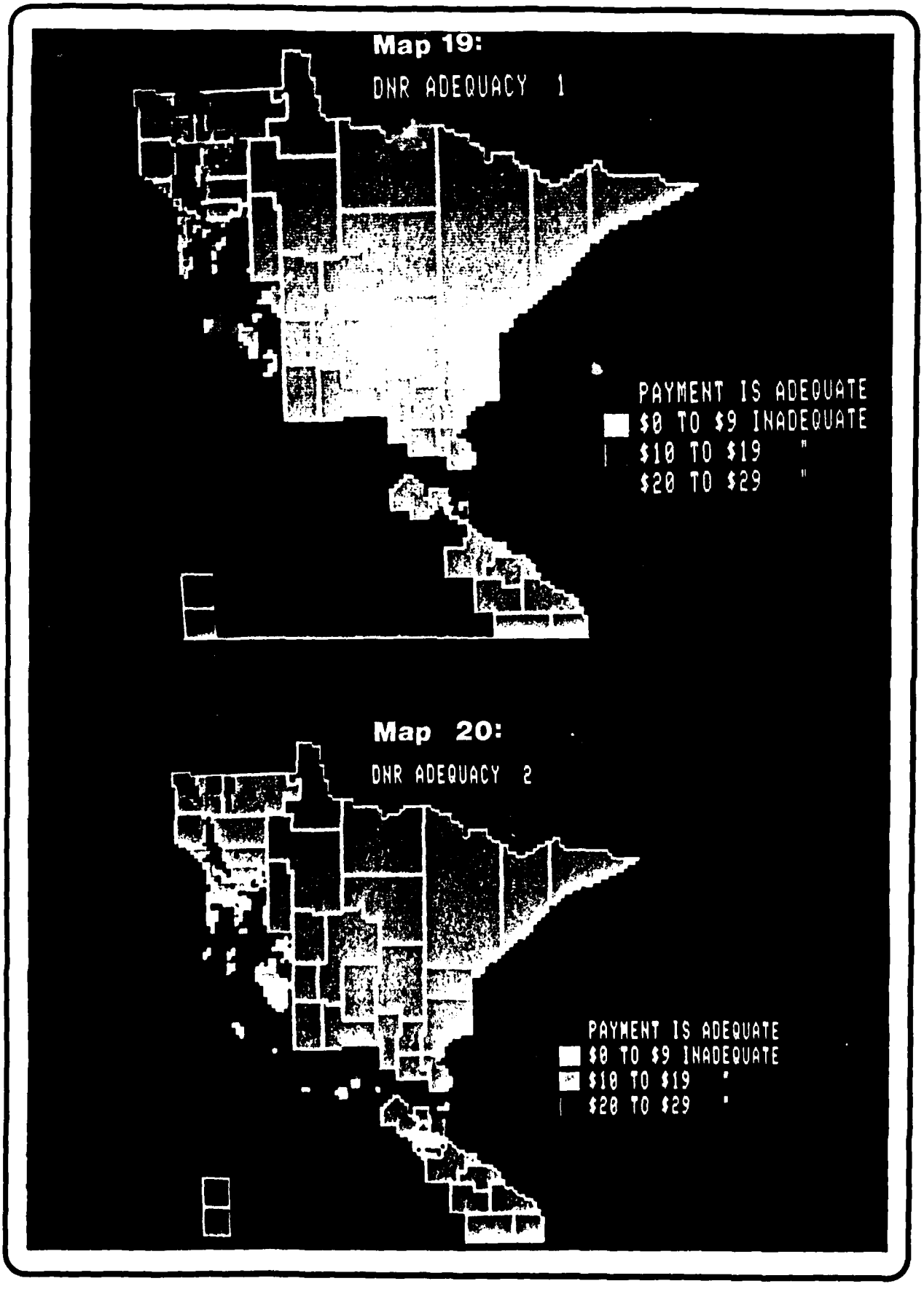
STATE WATER BANK ADEQUACY

Before-Income-Tax Analysis

Subtracting net returns before income tax from the estimated State Water Bank payment (Map 7) allowed preparation of Map 19, "DNR Adequacy 1." This map shows that the payment level proposed by the DNR is adequate through much of the State. The only major exception is in the northwestern part of the State (Pennington, Red Lake, Marshall, Kitson, and Roseau Counties). Much of this area is in the $0 to $9 inadequate range. Smaller areas show up as more inadequate than $10 per acre per year. A small part of Washington County, just southeast of the Twin Cities, also appears to have insufficient payment levels. Throughout the remainder of Minnesota, however, the DNR's proposed land-value-based payment level appears adequate.

After-Income-Tax Analysis

The State Water Bank rental payment will be subject to income tax, just as the Federal Water Bank payment is taxable, because it is considered rental income. For farmers in a zero-percent marginal tax bracket (e.g., those with high debt and a good knowledge of tax laws), the after-income-tax payment is identical to the before-tax amount. For those in a 40-percent marginal tax bracket, the analysis of Map 20 ("DNR Adequacy 2") shows the after-tax difference between the State Water Bank payment, per year and per acre, and the potential net returns of drainage. The pattern is similar to that of the before-income-tax analysis. Once again, northwestern Minnesota contains areas that are $0 to $9 inadequate per acre per year, as does the southeast portion of the Twin Cities metropolitan area. In the rest of the State, the proposed State Water Bank payment appears to exceed the net returns from drainage, after all taxes.


Map 19:
DNR ADEQUACY 1
PAYMENT IS ADEQUATE
$0 TO $9 INADEQUATE
$10 TO $19 "
$20 TO $29 "
Map 20:
DNR ADEQUACY 2
PAYMENT IS ADEQUATE
$0 TO $9 INADEQUATE
$10 TO $19 "
$20 TO $29 "

Discussion

In general, payment levels appear adequate. Those areas with deficient payment levels are not seriously deficient. "Inadequacy" between $0 and $9 is not severe. The State Water Bank payment, in contrast to drainage and cultivation of a wetland, is a risk-free venture for the farmer. If the process of signing up for the State Water Bank program does not involve excessive costs or red tape, risk-conscious farmers in the $0 to $9 inadequate" areas might consider the program to be a better bet.

The analysis showing such a large area in the "payment is adequate" category raises the question of whether the program is overgenerous. Indeed, one danger of these programs is the possibility of their paying farmers not to do what they would not do anyway. However, the principles behind the State Water Bank regulations on payment levels are sound and do not seem to lead to excessive payments. It makes sense that the value of any land is its sales value minus development costs (i.e., drainage costs). Moreover, available data show that rental rates are about 4 1/2 to 5 percent of land sales values. Thus, the payment formula, which incorporates each of these ideas, is sound.

The true test of its soundness, of course, is through experience. If the program is allowed to operate as designed, the DNR will be able to evaluate acceptance of the payments and make adjustments to "fine tune" the program. Such experience could yield a much better understanding of payment adequacy than that available solely through the kind of analysis presented in this report.

Operation of the program may be slowed if the State legislature further modifies the public waters and wetlands program, which remains controversial. In addition, the State Water Bank may be threatened by budget limits. Minnesota schools and municipalities have recently been forced by the State to reduce their budgets because of recession-related shortfalls in State tax revenues. One may wonder what the fate of State wetland preservation programs will be when other budgets are being cut back.

WETLANDS TAX CREDIT ADEQUACY

As previously noted, analysis of the effect of the wetlands property tax credit has already been incorporated into computation of the net returns of drainage (pages 29-31). Analysis showed that the credit is worth up to $8 per wetland acre per year. The loss of the credit, coupled with the additional property tax assessed on drained land, means that drainage will cost most farmers from $8 to $22 per acre in property taxes each year. Through much of agricultural Minnesota, the amount is greater than the payment level for the Federal Water Bank program.

The cost of obtaining information and enrolling in the wetlands property tax credit program is low. The fact that agreements are for 1 year at a time should encourage enrollment. Administration of the program probably will not be overly costly. In short, the wetlands property tax credit program has many merits and may assist in retarding the rate of wetland drainage. At the very least, the program destroys the traditional pro-drainage argument that "farmers are paying taxes on wetlands and therefore must drain to get some return on the land."

As a side benefit, the program can provide enrollment data on a year-to-year basis that would allow some measure of the rate of wetland drainage. Such data are currently lacking. It would seem desirable for the Department of Revenue (or some other agency) to compile and publish county-by-county statistics on enrollment in the wetlands property tax credit program.

SUMMARY

This section has compared the estimated net returns from wetland drainage with the dollar amounts available from government programs. The analysis has been done on a before- and after-income tax basis. These comparisons provide one way to judge the programs' adequacy.

What the analysis has shown is that the Fish and Wildlife Service easements and proposed State Water Bank payments appear greater than the net returns from drainage through most of the study area. The exception is in

northwestern Minnesota. Federal Water Bank payments, however, are less than net drainage returns through a number of areas, particularly when evaluated after income tax. The effect of income tax was analyzed because the tax applies to government payments as well as crop income.

Again, this analysis represents only one manner of determining adequacy of the programs. It compares one particular factor, economic returns, which have been calculated in one particular way. Nevertheless, the comparison is useful if it helps to explain why the different programs may have had different success rates and what might be done to improve the programs.

REPORT SUMMARY AND CONCLUSIONS

This report has analyzed the economic considerations that affect farmers' decisions to drain wetlands or enroll in government programs. It has (1) reviewed four of the compensation and incentive programs in Minnesota that encourage preservation, (2) estimated the annual net return per acre to a farmer who drains, and (3) compared the dollar amount available through the government programs to the economic return from drainage. The government programs described are the Federal Water Bank, Fish and Wildlife Service easement and acquisition program, State Water Bank, and wetlands property tax credit. The net return to a farmer for conversion of wetland to cropland has been estimated using a "partial budget analysis," or the calculation of changes that result from drainage on both the cost and revenue sides of a farmer's budget.

The terms and payment amounts vary considerably among the four government programs. In the prairie pothole region of Minnesota, for example, annual per-acre payments are $10 for Federal Water Bank, $10 to $35 for Fish and Wildlife Service easements, $15 to $45 for State Water Bank, and $1 to $4 for the wetlands property tax credit. (The total change in property tax would be from $6 to $12 for this area, because drained wetland would be subject to property tax as well as ineligible for the tax credit.) The tax credit, which goes into effect for taxes payable in 1981, is a near-automatic feature that works in conjunction with the other programs.

The net return from drainage was analyzed on a before- and after-tax basis. Net returns after all taxes were found to vary within a reasonably narrow range of -$10 to +$30 per year per acre through the study area. The most critical and most volatile component of net returns is crop prices. If crop prices rise to higher levels, the net return from drainage would increase significantly. Both the property tax and income tax are seen as having an appreciable effect on drainage returns. The income tax subsidizes losses for those areas where pretax returns are negative, and reduces gains in other areas. Therefore, it tends to equalize the net returns of drainage.

Comparison of estimated net returns with program payment has shown that easements from the Fish and Wildlife Service and proposed State Water Bank payments exceed the estimated drainage returns in a large portion of the area studied. The Federal Water Bank payments, on the other hand, do not exceed the economic return from conversion of wetlands to cropland in as many areas. Income tax was found to apply to government payments as well as to crop income; therefore, the comparisons of net drainage returns to wetland preservation program income were made both on a before- and after-income tax basis.

"Adequacy" is a term with many different definitions. The most general and most acceptable criterion for adequacy of wetland preservation programs would be that they meet their stated objectives. Clearly, a payment level that exceeds probable drainage returns is going to add to a program's level of success. However, a myriad of factors, some of them inside and others outside the realm of economics, will affect the success of these programs. Thus, while the work of this report is helpful in understanding economic rationale for drainage or preservation, it is not sufficient for conclusive statements on the adequacy of the various preservation programs or on whether the programs represent an efficient use of public dollars.

Additional studies certainly may add more to an understanding of drainage activity. For example, surveys of those who have drained wetlands might help verify estimates on drainage returns, shed further light on the

sociological aspects of drainage decisions, determine how widespread knowledge of preservation programs is, and discover farmers' reasons for draining instead of enrolling in the government programs. Such surveys may soon be under way.

Nevertheless, the brightest source of information on the extent of and reasons for drainage activity is through the preservation programs themselves. It would be useful for administrators of these programs to tap newly available data sources such as the wetlands property tax credit program. It would also be helpful for program administrators to periodically monitor acceptance or application rates to detect the need for adjustments in their programs. Finally, it would benefit these administrators to meet and exchange information and ideas on their agencies' activities. These actions by resource stewards in Minnesota, allied with research efforts of others, may help the State come to grips with the pervasive and emotional issue of wetland management.

APPENDIX A

DESCRIPTION OF MLMIS METHODOLOGY AND DOCUMENTATION OF ASSUMPTIONS USED FOR ANALYSIS

APPENDIX A

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APPENDIX A

DESCRIPTION OF MLMIS METHODOLOGY AND DOCUMENTATION OF ASSUMPTIONS USED FOR ANALYSIS

INTRODUCTION

In preparation of this report maps have been used extensively to (1) describe the principal government programs that directly affect wetland drainage, (2) display the net returns available to a farmer who chooses to drain a wetland, and (3) compare payment levels available through wetland preservation and enrollment in government programs with the net returns available through drainage. These maps were prepared using the Minnesota Land Management Information System (MLMIS). This appendix will describe the MLMIS and how it was used and explain the assumptions made in the analysis for this report.

USE OF THE MLMIS

The MLMIS is a planning tool administered by the Minnesota State Planning Agency. It includes digitally encoded files on State resources and computer software and hardware used for manipulation of the files. Among the sets of data is a statewide file established on a 5-square-kilometer grid cell basis. This file includes information on geopolitical characteristics (e.g., county boundaries) and physical specifications (e.g., soils and geomorphic regions). Information on individual 5-square kilometer cells, or sets of cells, can be retrieved in statistical, tabular, or map format.

In addition to allowing planners to obtain the information on file, the MLMIS can be used to analyze land use. For example, numbers may be assigned to sets of cells to rank the cells for land use capability factors. The rankings for each factor can then be mathematically combined to derive a composite ranking for each grid cell.

The State Planning Agency used this methodology to produce its 1979 report, Minnesota Cropland Resources. This report gave grid cell rankings based on soil type, slope, climate, and land ownership. Rankings were combined to produce a composite map showing productivity potential for the State's cropland, after considering physical and cultural/ institutional constraints on cultivation.

The basic principle involved for this analysis was used by Ian McHarg in his 1969 work, Design With Nature. However, McHarg's methods involved physically placing shaded transparency maps on top of each other to derive a composite map. The MLMIS, on the other hand, combines information that is digitally encoded and uses data processing equipment to produce a composite.

The methodology of this study and the transparency overlay technique described by McHarg and others differ in two other respects. First, this study does not assign dimensionless numeric rankings to geographical areas, but assigns dollar amounts to them for each of the factors that determine the economic returns from wetland drainage. Having all data expressed in terms of dollars allows the different factors to be combined to derive composite outputs which also will be in dollar terms, rather than being unit-free rankings.

The second difference is that the various factors will not be combined only through addition and subtraction, but also in lengthy computations that introduce appropriate coefficients and involve multiplication and division. It is not possible to perform those computations when using the physical overlay process. The computer, on the other hand, deals with them easily.

ECONOMIC FACTORS THAT VARY FROM CELL TO CELL

A number of assumptions were made in creating the 5-square kilometer grid cell data files for this study. The following five economic factors affect wetland drainage and can vary from cell to cell: gross returns, production costs, subsurface drainage costs, surface drainage or outlet costs, and property tax. This section will discuss and present maps for each factor.

Gross Returns

A proper estimate of gross returns per acre of drained wetland must consider the mix of crops in an area, yield for these crops, the productivity of drained wetland in relation to that of other lands, and the price received for crops. For the analysis of these factors, data were reviewed on a county-by-county basis. County data were than input to the MLMIS computer and "smoothed" to develop a contour map of the State for gross returns.

Data from the annual publication Minnesota Agricultural Statistics were used to determine the average crop mix and the average crop yield expected for 1975-79 in each county in the study region for the seven principal crops grown in Minnesota - corn, soybeans, all wheat, oats, barley, sunflowers, and all hay. The following table displays sample calculations for Otter Tail County.

Calculation of average crop mix and average yield per acre: Otter Tail County

	Harvested acres							
Year	Corn	Soybeans	All wheat	Oats	Barley	All hay	Sunflowers	Total
1975	60,900	20,200	85,400	128,800	40,900	168,100	7,100	511,400
1976	44,400	9,800	90,700	125,200	39,700	173,000	3,300	486,100
1977	99,800	10,700	88,000	139,600	38,400	167,900	9,800	554,200
1978	105,400	11,400	82,000	129,000	41,100	166,000	11,800	546,700
1979	100,000	51,500	73,500	132,000	38,100	168,500	35,000	598,600
Total	410,500	103,600	419,600	654,600	198,200	843,500	67,000	2,697,000
Average	82,100	20,720	83,920	130,920	39,640	168,700	13,400	539,400
Percent	15.2	3.8	15.6	24.3	7.3	31.3	2.5	100.0

	Yield per acre						
Year	Corn (bushels)	Soybeans (bushels)	All wheat (bushels)	Oats (bushels)	Barley (bushels)	All hay (tons)	Sunflowers (cwt)
1975	46.0	20.8	24.0	42.6	34.3	2.4	14.5
1976	32.8	9.6	22.8	31.3	24.4	1.1	9.7
1977	68.1	27.5	37.2	59.6	50.0	2.4	15.0
1978	68.1	23.9	26.6	53.5	44.1	2.5	15.7
1979	68.0	25.0	30.0	53.0	48.0	3.0	13.7
Average	56.6	21.7	28.1	48.0	40.2	2.3	13.7

Farmers often claim that drained wetlands produce more than other croplands. In some years, yields may be higher on drained wetlands. The higher yields may result from the relatively high nutrient levels of wetland soils which have served as nutrient "sinks." However, drained wetlands will be more saturated than surrounding croplands. Also, because drained wetlands are typically low-lying areas and hollows, crops growing on them may be more susceptible to frost damage. These drawbacks offset the advantages of wetland soils and explain why Soil Conservation Service and University of Minnesota soil scientists now estimate that drained wetlands will be equal to other croplands in productivity. In accordance with their current findings, this report assumes that yields on wetland soils will be the same as average county yields.

The choice of crop prices to use is wide. Today's or last year's prices could be used. However, crop prices can fluctuate greatly. Some crop prices rose as much as 50 percent in 1980 alone. For this reason, a "normalized" or average set of prices should be used. Even then, there is a choice. In planning water resource developments, the Water Resources Council directs the Corps of Engineers and other Federal agencies to use the Council's "current normalized prices." These prices are based on a 5-year weighted average. Unfortunately, some of the prices listed for 1980 do not seem to represent long-term trends. For example, the current normalized price for wheat is given as $2.99 per bushel. The target price under the 1980 farm program is $3.63, and the current (October 1980) price is $4.22. The current normalized price for corn is $2.02, but with the rapid increases in fuel and other production costs in 1979-80, it is unlikely farmers could make any profits at that price.

Because this report does not involve the formal benefit analysis used for a Corps of Engineers project proposal, some freedom exists in the choice of prices. The prices chosen for this analysis are "Five-Year Planning Prices." They are prepared every autumn by University of Minnesota agricultural economists. Grain terminal prices from that publication have been adjusted downward by approximately 7 percent to derive an on-farm price. These prices, along with 15 October 1980 and current normalized prices, are listed in the following table.

Prices for Minnesota crops

Crop	15 Oct 1980 price[1]	Current normalized price[2]	Five-year planning price[3]
Corn	$2.78	$2.02	$2.50
Soybeans	7.48	6.13	6.40
All wheat	4.22	2.99	3.50
Oats	1.62	1.12	1.35
Barley	2.93	1.91	2.10
Sunflowers	10.32[4]	10.09[5]	10.50
All hay	60.50	45.14	40.00

(1) Source: Crop Reporting Board, USDA, Agricultural Prices, 31 October 1980.
(2) Source: Water Resources Council, Agricultural Price Standards, as revised, June 1980.
(3) Source: University of Minnesota, Department of Agricultural and Applied Economics, "Farm Planning Prices," October 1979. Adjusted downward 7 percent from terminal prices to derive on-farm prices.
(4) Cash price on Minneapolis Grain Exchange as of 15 October 1980, adjusted downward 7 percent to estimate on-farm price.
(5) 5-year average price.

The assumptions on crop mix, crop yields, relative productivity of drained wetlands, and long-run crop prices are combined in a calculation for each production region. The calculation defines weighted gross returns per crop per acre as:

(Percent crop mix) X (crop yield per acre) X (relative productivity of drained wetlands) X (long-run crop prices).

The results for all crops in each region are added to compute weighted gross returns per region. The following table shows how these calculations were made for Otter Tail County.

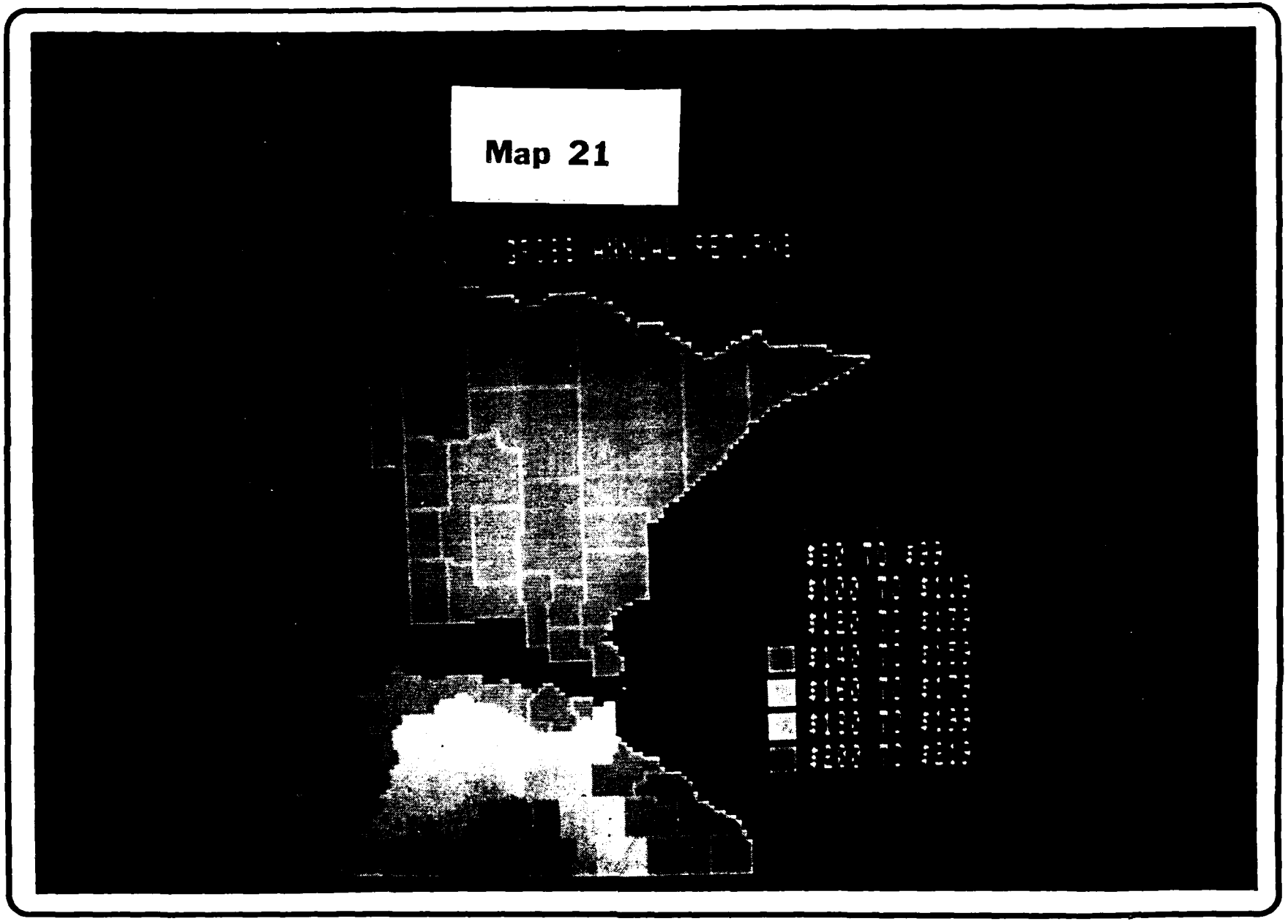
Calculation of gross returns attainable with wetland drainage for Otter Tail County

Crop	A Percentage crop mix	B Yield per acre	C Relative productivity of drained wetland	D Long-run crop prices	Weighted gross returns (AxBxCxD)
Corn	15.2	61.0 bushels	100 percent	$2.50	$23.18
Soybeans	3.8	22.9 bushels	100 percent	6.40	5.57
All wheat	15.6	28.1 bushels	100 percent	3.50	15.34
Oats	24.3	48.3 bushels	100 percent	1.35	15.84
Barley	7.3	40.0 bushels	100 percent	2.10	6.13
All hay	31.3	2.3 tons	100 percent	40.00	28.80
Sunflowers	2.5	14.1 cwt	100 percent	10.50	3.70
Total	100.0				98.56

Data from each county were input to the MLMIS computer and modified by a "smoothing" routine to obtain a contour map for the State. Map 21, the result of these computations, displays the expected gross return per acre per year from wetland drainage.

Production Costs

If a farmer is going to grow crops on a drained wetland, he must till the soil, plant seed, fertilize, and harvest. Each operation involves costs. The farmer may save some money on his upland operations if he drains and cultivates the wetland because he does not have to spend extra time or use extra fuel to farm around the wetland. The amount saved may be significant. Leitch and Danielson reported that 26 percent of the farmers surveyed in Otter Tail, Grant, and Douglas Counties said that the better use of their fields was the most important factor in determining whether to drain wetlands. Also, wetland drainage may lessen costs associated with having an expensive piece of farm equipment, such as a planter or combine, stuck in the wetland. Repair bills and delays in planting or harvesting may be costly.


Map 21

Each year, agricultural economists at the University of Minnesota determine farm management budgets for crop production regions. The budgets indicate the estimated costs of each operation and the production input used to grow each crop. Costs are listed on a per-acre basis and are broken down between cash or out-of-pocket costs and noncash costs which include items such as machinery depreciation.

Because the additional acreage from wetland drainage on any one farm will not usually be great, farm machinery would probably not wear out sooner nor would new equipment be needed to cultivate the drained land. Therefore, cash costs from the farm management budgets were used to approximate the per-acre production costs on drained wetlands. Land taxes were excluded from the cash costs because the effect of land taxes will be analyzed more closely later.

Labor and fuel account for 15 to 30 percent of cash costs. Fertilizer, herbicide, seed, and other costs account for the rest. As noted previously, some savings in operating costs will be realized because wetland drainage reduces the risk of stuck machinery and eliminates the extra cost of cultivating around the wetland. Unfortunately, no research currently exists to document these savings. This report reflects the savings by reducing cash costs listed on the budgets by 20 percent. This percentage was chosen with the idea that much, if not all, of the additional labor and fuel costs would be offset by cost savings on other lands. It is hoped that future research will eliminate the need for subjective judgment in determining an appropriate adjustment factor.

Production costs per acre for each crop in each region were weighted by the percentage crop mix in the region to determine a single production cost for each region. Sample calculations are given in the following table. The summary information is also shown on map 22.

Production costs on drained wetlands for southwest Minnesota

Crop	A Percentage crop mix (percent)	B Cash costs(1)	C Reduced costs on other land(2)	Weighted production costs (Ax(B-C))
Corn	40	$116.88	$23.38	$37.40
Soybeans	25	44.83	8.97	8.96
All wheat	15	54.41	10.88	6.53
Oats	10	49.68	9.94	3.97
Barley	0	--	--	0
Sunflowers	0	--	--	0
All hay	10	48.69	9.74	3.90
				60.76

Production costs per acre per year = $60.76 (use $61).

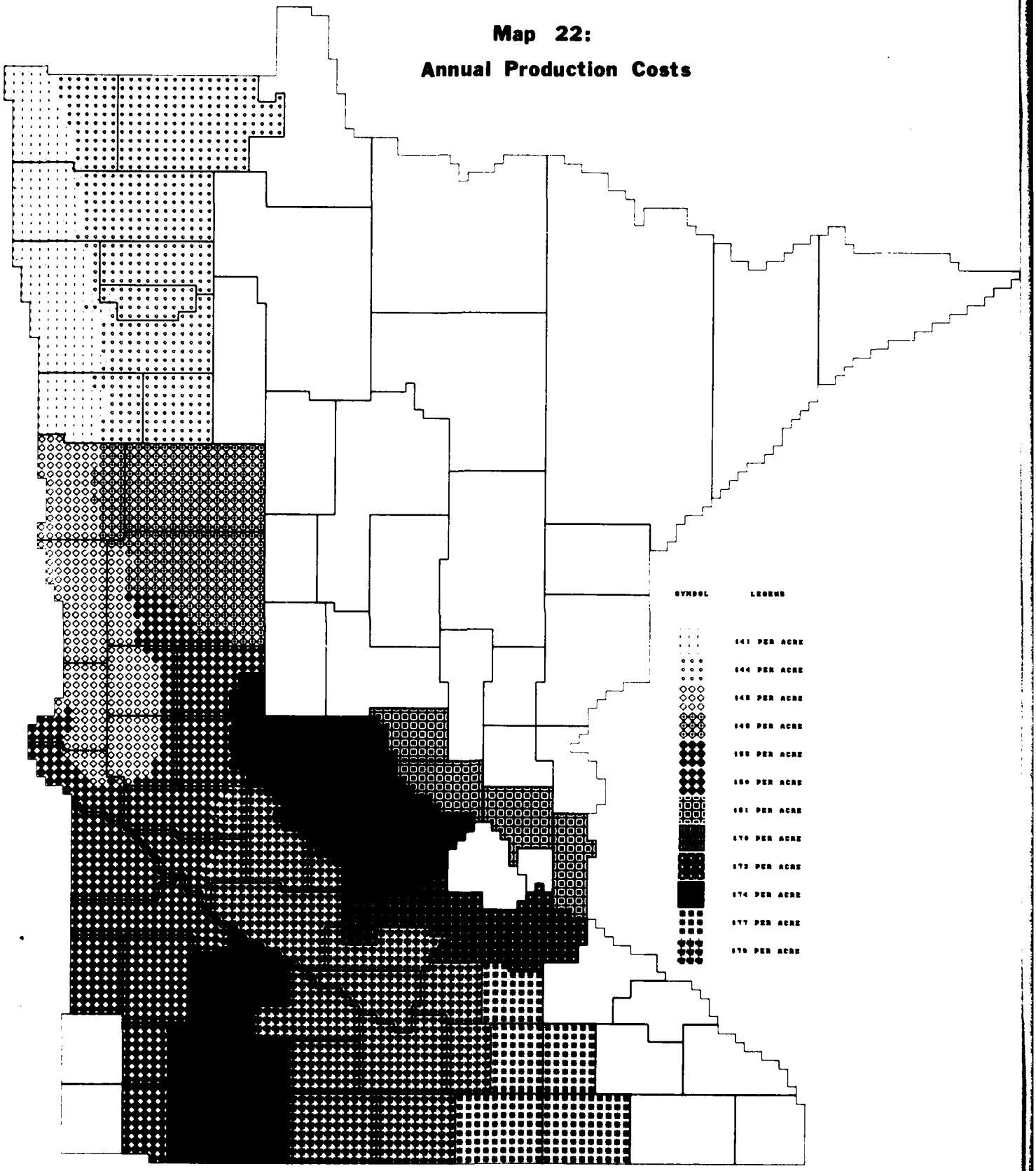
(1) Source: University of Minnesota, Department of Agricultural and Applied Economics, What to Grow in 1980 (Publication FM 418), January 1980. Land taxes have been excluded.

(2) 20 percent of cash costs. See text.

Summary of production costs for all production regions

Production region	Production costs per acre per year
1	$42
2	44
3	45
4	49
5	55
6	74
7	61
8	61
9	70
10	79
11	73
12	77

Map 22:
Annual Production Costs

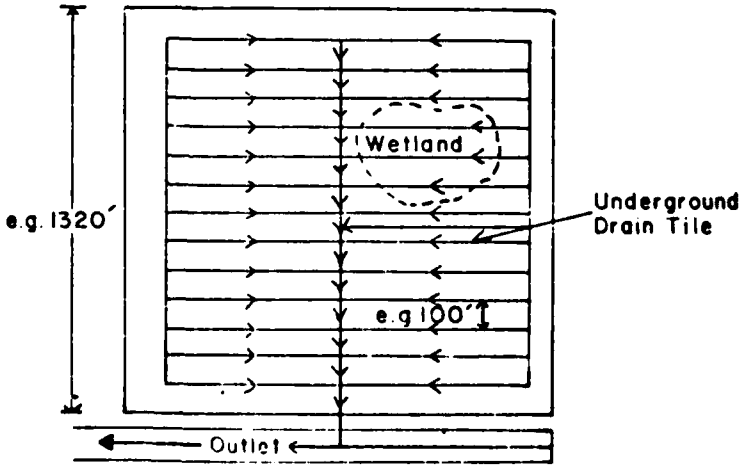


Subsurface Drainage Costs

In the corn- and soybean-growing regions, wetlands are often the natural exposure of the local groundwater (see the following figure). Drain tile is typically used to drain this kind of land. A tile drainage system is an underground network of loosely connected clay or cement pipes or perforated plastic pipe. The pipes are placed in parallel rows, usually at a depth of about 3 feet. Water flowing through the soil passes into the pipe or drain tile through gaps at the connections or through the perforations and is channeled to an outlet. The second figure shows a plan view of an underground tile drainage system that might be found in an extremely flat area.

CROSS SECTION OF TYPICAL WETLAND THAT MIGHT BE DRAINED WITH TILE DRAINAGE SYSTEM

PLAN VIEW OF A TILE DRAINAGE SYSTEM



A subsurface drainage system may be installed exclusively for draining a wetland, but it is more commonly a component of general farm field drainage. For example, a farmer in southern Minnesota might install a field drainage system to drain a quarter section (160 acres) with only 5, 10, or 20 wetland acres. Upland areas are drained to improve crop yields by allowing more timely operations and inducing deeper, faster root development through improved aeration and mineral movement through the soil.[12]

Subsurface drainage is rarely used in the small grain and hay producing regions because tile is generally ineffective with the "tight" soils prevalent in these regions. Thus, subsurface drainage costs for these regions are zero. In other regions where subsurface drainage is needed, costs of the underground system are determined by the installation depth, diameter of pipe, and spacing of the rows. The first two factors determine the cost per running foot of tile; the last factor determines how many running feet of drain tile will be needed per acre.

Field personnel from the Soil Conservation Service (SCS) and University of Minnesota crop experiment stations, farmers, and drainage contractors were contacted to assist in developing assumptions on costs per running foot and tile spacing. They indicated that $0.80 per running foot is representative for installed drain tile. They also pointed out that 100-foot spacing is typical for less heavy soils (such as loamy and sandy soils), while 80-foot spacing was probably more typical for the heavier clays. They noted that there appears to be a general trend toward closer spacings, and that 50-foot spacing is no longer rare. However, 80- to 100-foot spacing was felt to be more standard.

The MLMIS file on geomorphic regions includes a description such as "sandy," "clayey," or "loamy" for each of the 99 geomorphic regions. It was assumed that 100-foot spacing would be used for the loamy regions, and 80-foot spacing for clayey regions. With the assumption of a cost of $0.80 per running foot, the cost per acre for tiling, exclusive of outlet costs, is $350 and $440 for the loamy and clayey regions, respectively. Calculations for these costs are given in the following table.

Tiling costs exclusive of outlet costs

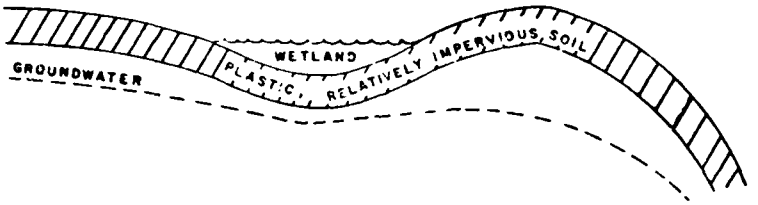
Region	Calculation
Loamy (100-foot spacing of rows)	1 foot tile/100 ft^2 x 43,560 ft^2/acre x \$0.80/foot = \$348.48/acre (use \$350/acre)
Clayey (80-foot spacing of rows)	1 foot tile/80 ft^2 x 43,560 ft^2/acre x \$0.80/foot = \$435.60/acre (use \$440/acre)

Map 23 shows the subsurface drainage costs assumed for the different regions.

Surface Drainage and Outlet Costs

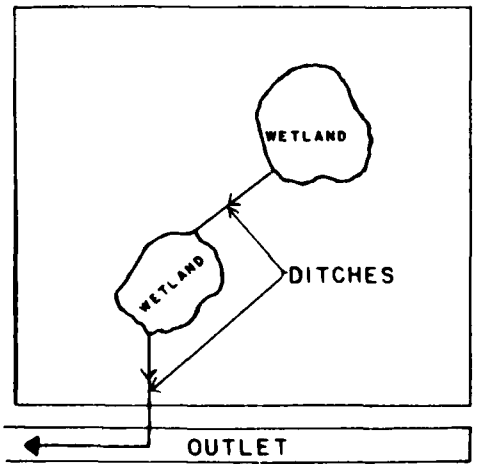
Other major costs in wetland drainage are the costs for surface drainage and outlets for underground tile. Any time a subsurface drainage system is installed, an outlet of some kind is needed. Ditches, streams, or county main drains might be used. Surface water must be drained if the kind of wetlands found in the small grain and hay producing areas are to be farmed. These wetlands are often depressions that are "sealed" on the bottom by a plastic soil that retards percolation of water through the bottom or sides. This situation is illustrated in the following figure. In this instance, no subsurface drainage is needed because the wetlands were not formed as the result of a high water table.

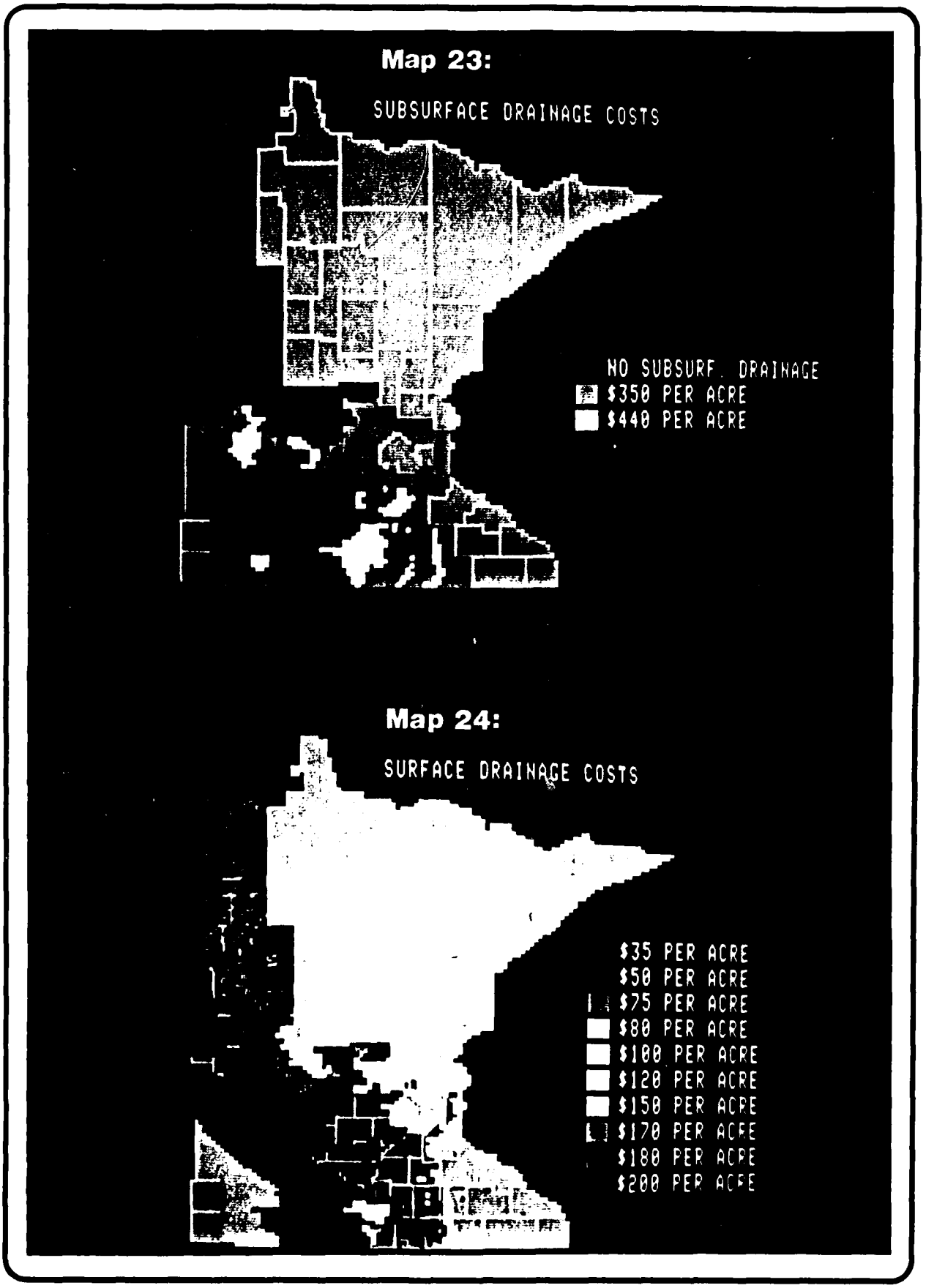
CROSS SECTION OF TYPICAL WETLAND THAT MIGHT BE DRAINED WITH DITCH DRAINAGE SYSTEM



The wetland shown in the above figure can be drained in two ways. The first method would be to dig ditches or form the land to provide a gravity outlet on the surface. A typical series of ditches is shown below.

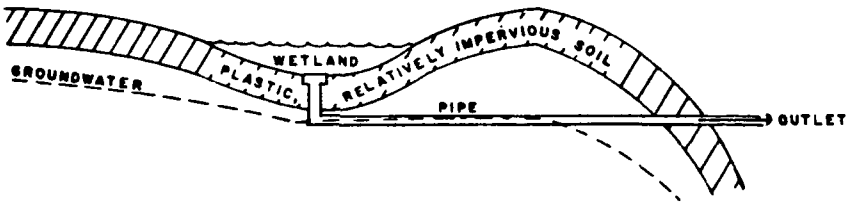
PLAN VIEW OF TYPICAL DITCH DRAINAGE SYSTEM




Map 23:
SUBSURFACE DRAINAGE COSTS
NO SUBSURF. DRAINAGE
$350 PER ACRE
$440 PER ACRE
Map 24:
SURFACE DRAINAGE COSTS
$35 PER ACRE
$50 PER ACRE
$75 PER ACRE
$80 PER ACRE
$100 PER ACRE
$120 PER ACRE
$150 PER ACRE
$170 PER ACRE
$180 PER ACRE
$200 PER ACRE

The other method would be to use concrete, clay, or plastic pipe (that is, drain tile) to provide an underground drain. This method should not be confused with the use of drain tile for subsurface drainage. In surface drainage, perforated pipe is not used and subsurface water is not carried by the pipe. The following figure shows one arrangement of drain tile for surface drainage. Surface water feeds through a sewer grate or through gravel and a screen to a buried pipe that channels it to an outlet.

DRAINAGE OF SURFACE WATERS
WITH CONCRETE, CLAY, OR PLASTIC PIPE
(CROSS-SECTIONAL VIEW)



The costs for surface drainage and outlets for subsurface drainage are among the most difficult of all drainage costs to estimate. These costs vary with the length of ditch or amount of pipe needed and the depth of cut needed for the ditch or to install the pipe. These factors are site-specific. Local topography and the presence or absence of streams, lakes, or other ditches will cause costs to vary, even from one farm to a neighboring farm. Further difficulties are encountered in trying to express these costs on a per-acre basis. The costs to drain a 5-acre and a 10-acre wetland area may be the same. At a cost of $2,000, the smaller wetland will cost $400 per acre while the large wetland will cost $200 per acre even though the system design is identical.

Assumptions used to estimate these costs were based on telephone or personal contacts with nine field employees from the Soil Conservation Service; six drainage contractors; the University of Minnesota Agricultural Extension Service and two field experiment stations; and seven farmers. Topography (as described in the MLMIS list of geomorphic regions) and the relative density of drainage ditches in different areas (also mapped in the MLMIS) were also used in developing assumptions. The basic principle used in estimating surface drainage costs was that the length of ditch or pipe needed would depend on the availability of drainage ditches and that depth of cut or placement would depend on the topography. In relatively flat areas, it was assumed that the farmers could do much of the excavation or land-forming work themselves and that the cost would be lower per cubic yard of material moved.

These assumptions are the basis for the estimated drainage or outlet costs of $35 to $260 per wetland acre. The regional variation for these costs is given on Map 24.

Property Tax

The fifth factor affecting drainage costs and varying among grid cells is property tax. The farmer has two property tax considerations when he is deciding whether to drain a wetland.

First, if the wetland is drained, the farmer no longer receives the wetlands property tax credit. This credit, which is described on pages 22-26, is available only if the wetland is not altered.

Second, if the farmer drains the wetland, he will have to pay property tax on the drained land. The drained land will be taxed according to its increased value as cropland.

The lost credit and higher taxes are properly considered costs of drainage, and therefore must be deducted from gross returns to compute net returns. These costs vary with land values, assessment ratios, and effective tax rates.

Calculation of the wetlands property tax credit and the increased property tax assessment are discussed on pages 22-26 and 31-32.

OTHER ECONOMIC FACTORS

Two additional factors are of great importance in the analysis of the economics of wetland drainage: the conversion of costs and returns to a common time base and the marginal income tax rate. These factors are not thought to vary significantly from region to region.

Conversion of Costs and Returns to a Common Time Base

The timing of costs and returns must be considered in economic analyses. All costs and returns, which are incurred either at one time in lump sums or over a period of time as a "stream," must be converted to a common time base. For this analysis, they are converted to present worth and amortized over the economic life of the drainage project. Thus, costs and returns can all be expressed on an average annual per-acre basis.

Assumptions are necessary on the timing of costs and returns and on appropriate present worth and amortization factors. The conversion factors should be based on the opportunity cost of capital before income taxes.

For this report, it is assumed that production and property tax costs are incurred in equal amounts each year. Gross returns are assumed to be 50 and 75 percent of their full potential in the first and second years, respectively, after drainage and 100 percent thereafter. Ditches constructed for surface drainage or as tile outlets are assumed every 7 years to require maintenance costs of one-third of first costs.[13]

The interest rate is assumed to be a reasonable proxy for the opportunity cost of capital. A 12-percent interest rate has been used in this report. This rate is considered reasonable for a long-term market rate.

The economic life of a drainage system is assumed to be 20 years. At the interest rate used, a longer assumed life for drainage investments would not significantly alter the results.

Marginal Income Tax Rate

The marginal income tax rate is the percentage of any addition to income that must be paid as State or Federal income tax. For example, if a farmer with a taxable income of $19,900 was paying $4,950 in income taxes but found that an increase in income to $20,000 raised his taxes to $5,000, his marginal tax rate would be 50 percent (a $50 increase in taxes divided by a $100 increase in income). His overall tax rate would be only 25 percent ($5,000 in taxes divided by $20,000 in taxable income).

Information provided by farm management specialists at the University of Minnesota indicates that the majority of self-employed Minnesotans fall into a marginal tax bracket of about 40 percent for combined State and Federal income tax and Social Security tax. However, many younger farmers, who have incurred high debt and interest charges as they have established and expanded their farms, may pay little, if any, income tax. Current tax laws may result in a marginal tax rate of zero percent for these farmers. As Leitch and Danielson discovered in their 3-county attitudinal survey, the young, expansion-minded farmers are precisely those who are most likely to be interested in draining wetlands. Thus, farmers who drain could fall in a 40-percent or 0-percent marginal tax bracket, or anywhere in-between.

Analysis for this report on net returns from drainage, therefore, is presented both on a before- and after-income tax basis. After-tax analysis assumes a 40-percent marginal tax bracket. Before-tax analysis shows the after-tax return to the farmer in a 0-percent marginal tax bracket.

SUMMARY

This appendix has described what the MLMIS is and how it was used and has also documented the assumptions used for the economic analysis. Assumptions were required on the five economic factors that vary regionally: gross returns, production costs, subsurface drainage costs, surface drainage or outlet costs, and property tax factors. In addition, assumptions were necessary to convert costs and returns to a common time base and choose an appropriate marginal tax rate. These assumptions were used to calculate, for the various agricultural regions of the State of Minnesota, the net returns available to the farmer who drains and cultivates a wetland.

APPENDIX B

REVIEW OF LAND SALES VALUE TECHNIQUES

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APPENDIX B

REVIEW OF LAND SALES VALUE TECHNIQUES

INTRODUCTION

Land sales analysis is one alternative to the partial budget technique for estimating the net return available from wetland alteration. The land value method involves analysis of actual sales of wetlands to see how much people have been willing to pay to own wetlands. The premise is that the amount paid for a wetland is determined by the wetland's ability to produce income. Thus, the net income available from wetland alteration can be estimated from the purchase price of a wetland.

The land sales method differs in two major respects from the partial budget method. First, the land sales analysis estimates the stock value of land, or the lump sum that people are willing to pay, while the partial budget technique estimates the income flow that use of the land can provide to the owner. Hence, there is a stock-flow distinction in the approach of the two methods. Second, the land value technique examines actual marketplace transactions, while the partial budget approach models marketplace behavior. In other words, the former method analyzes what has happened, while the latter predicts what might happen. Thus, the techniques differ significantly.

This appendix will discuss the land sales analysis method by reviewing applications of the technique in wetland valuation studies by Gupta and Brown.

REVIEW OF WORK BY GUPTA

One variation of the land sales analysis method was prepared by Gupta in 1973.[15] In his work, Gupta described 41 transactions from 1962 to 1971 involving Massachusetts wetlands, listing the size of each parcel being sold, actual sales price per acre, per-acre price expressed in 1972 dollars,

and general characteristics of each parcel. Parcel size varied from 0.3 to 1,500 acres. The wetlands involved were predominantly riverine and were located both in rural and urban areas. Information on the transactions was obtained by Gupta from wetland owners, assessors, conservation commissions, and the Massachusetts Department of Natural Resources.

Gupta found that the sales prices varied tremendously. The lowest price was $120 per acre, and the highest was $77,000 per acre. Ten of the 41 parcels were sold for $120 to $1,000 per acre; 17 for $1,000 to $5,000 per acre; and the remaining 14 for more than $5,000 per acre. The highest values were found, not surprisingly, in metropolitan areas. Parcels containing wetlands along Route 128 in the suburban Boston area, for example, were selling in 1972 for $16,500 per acre. Developers apparently felt that even when costs of filling were considered, this land was a "good buy" in comparison with upland real estate in that high-value area.

Gupta did not attempt to compute average values from his data or analyze the data in any other fashion. Two factors would deem such analysis inappropriate: extreme variation in the sample of transactions and inability to determine a price per acre of wetland. The parcels sold varied greatly in size, proximity to urbanization, development costs, and probable final use. Moreover, the parcels differed in the percentage of wetland that each contained. Some parcels were 100 percent wetland; others were only 10 or 20 percent wetland. Since sales price was known for the entire parcel but not for the wetland portion alone, it was not possible to establish a price per acre of wetland. Therefore, Gupta did not try to compute average wetland values or perform any other analysis on the land value data.

The approach used by Gupta in noting sales values for parcels containing wetlands would not have been adequate for the regional analysis of income potential of wetland alteration that is contained in this report. Even Gupta notes explicitly that the transactions data set is useful as an

indication of the general magnitude and source of wetland values but not as region-specific estimates of the potential net return from wetland alteration. The work is certainly not without value. The indicated range of wetland prices is enlightening. It might be useful to collect and report similar data for land sales in the Twin Cities or other urban areas in Minnesota, and administrators of the programs leasing, purchasing, or obtaining easements on wetlands would be wise to casually monitor selected rural wetland transactions from time to time. However, it is clear that Gupta's approach would not have sufficed for this report.

REVIEW OF WORK BY BROWN

Brown has also analyzed data on sales prices for wetlands.[16] His work used a multiple regression analysis to estimate the effect of Fish and Wildlife Service wetlands easements on the price of agricultural land in the prairie pothole region. The estimate was expected to show how much wetlands' prices were discounted when drainage was restricted (i.e., encumbered) by easements. In other words, the study was designed to indicate how much less people were willing to pay for a wetland that they would not have the privilege of draining and cultivating, and, hence, how much extra people would pay for that privilege. This extra amount was hypothesized to be equivalent to the capitalized (stock) value of the potential cash inflow from the wetland if drained.

Brown used data from 134 agricultural land sales from 1973 and 1974 in North and South Dakota. The sales data were grouped by location into three different regions, with each region containing an unspecified number of counties. His multiple regression model theorized price to be a function of five factors: the number of acres of cropland, grassland, wetlands, and encumbered wetlands and a random error term. The model then determined coefficients for each region for each of the factors and computed statistics on variance within the sample data for each region.

In many ways, Brown's approach is superior to Gupta's research, for it allows for analysis and estimation of the capitalized value of wetland income potential. Brown's data are much more uniform: the land sales in

each region were all for unimproved cropland with roughly similar physical attributes and production potential. Moreover, his regression model could deal directly with the problem of the parcels having varied percentages of cropland, grassland, and unencumbered and encumbered wetland. Brown's technique is sound and, unlike Gupta's, it seems to allow analysis of the average marketplace value of wetland.

However, Brown's results were inconclusive. He was able to estimate the differences in the capitalized value of unencumbered and encumbered wetlands at $18.56, $35.60, and $166.90 per acre in his three regions, but the results were not significantly different from zero in two of the three regions. Hence, the model was not conclusive even in demonstrating that wetland prices are discounted in the marketplace when the wetland is subject to drainage easements. Because of the disappointing results of Brown's work, his land sales analysis method was not chosen for this study.

DISCUSSION AND CONCLUSIONS

This appendix has discussed the salient differences between land sales analysis and the partial budget technique for deriving estimates of the income potential of altered wetland. It also has reviewed two examples of land sales studies found in wetlands valuation literature. The approaches in the two studies had deficiencies that rendered them inappropriate for the analysis of this report.

However, the two approaches should not be totally discarded. Each can be a valuable tool, even if not the right tool for this report. The idiosyncrasies of land sales are difficult to understand and perhaps will inevitably mean disappointing results from multiple regression analysis such as Browns's, but his model might yield statistically significant results with a data set chosen in the future. Periodic monitoring of wetland transactions, similar to Gupta's work, can be a useful way of sensitizing wetland managers in the State to the magnitude of values for altered wetlands. Thus, these land value techniques, while inappropriate for this study, may be helpful at some time to those in government who make decisions affecting the allocation of scarce wetland resources.

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